ENGINEERING AND

BOILER HOUSE REVIEW

ESTABLISHED 1899

TWO SHILLINGS & SIXPENCE

VOL. 74 NO. 8 • THE PIONEER STEAM JOURNAL • AUGUST, 1959

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For even temperatures use DEWRANCE -YARWAY

300°F

STAINLESS STEEL IMPULSE STEAM TRAPS

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- Suitable for all pressures up to 400 lb/in² 842°F without change of valve or seat.
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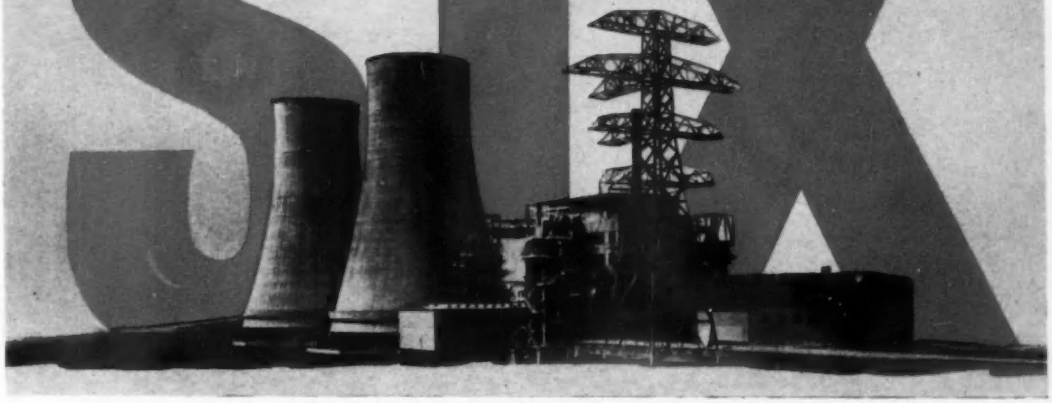

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Permutit have now obtained contracts for supplying "Deminrolit" plant to six Atomic Power Stations. This follows the successful installation of "Deminrolit" plant for providing feed water for heat exchangers at the world's first Atomic Power Station at Calder Hall. "Deminrolit" plant is but one of a complete range of plants designed and manufactured by Permutit to provide perfect feed water for heat exchangers and boilers of ALL types and pressures.

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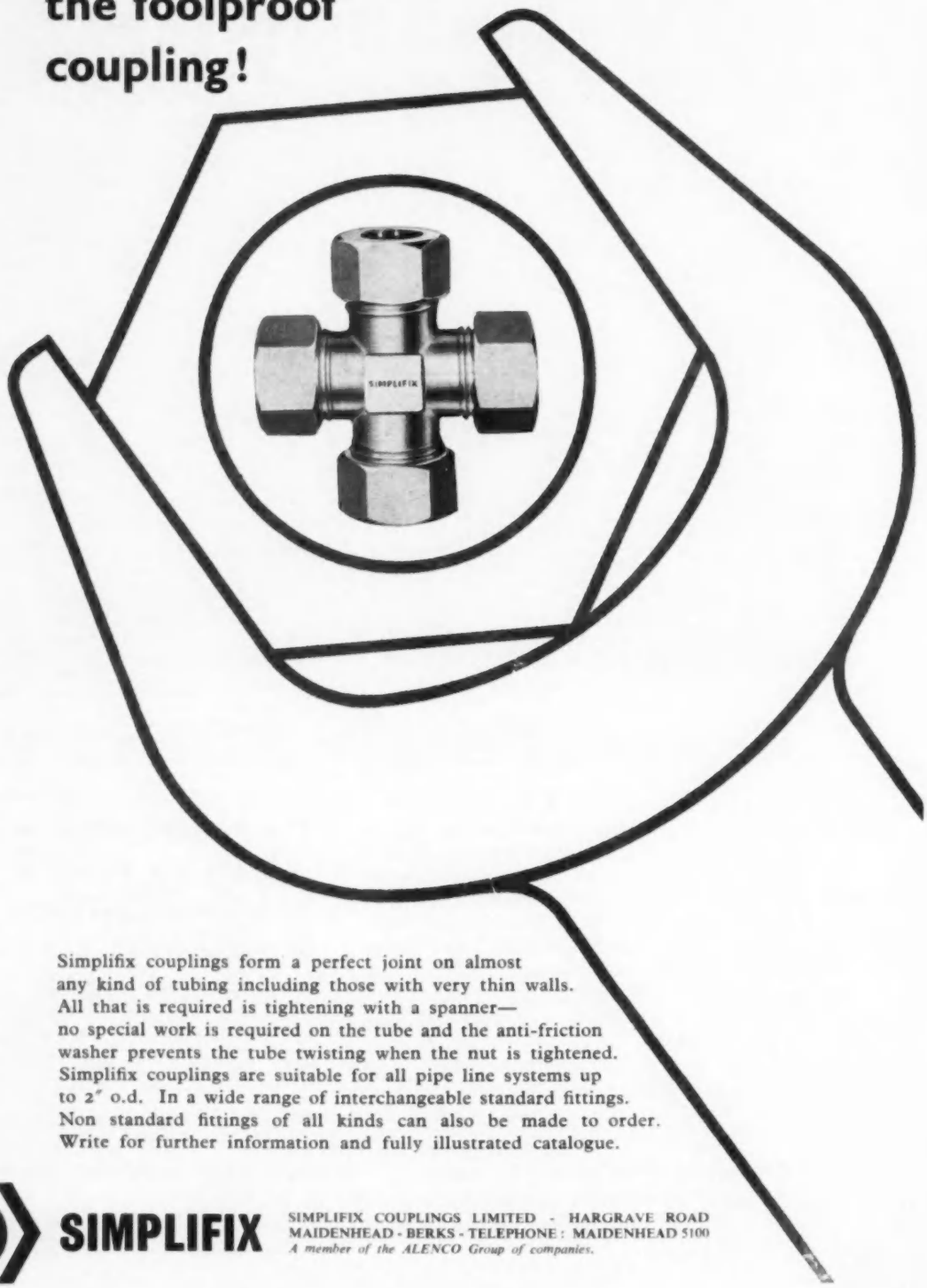

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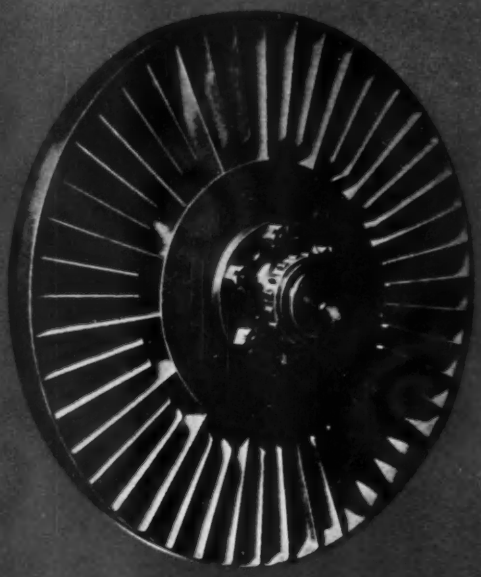

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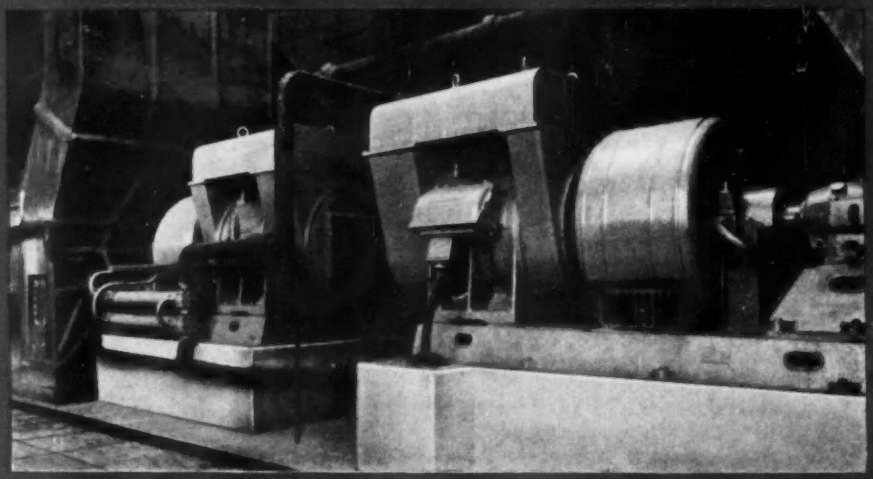

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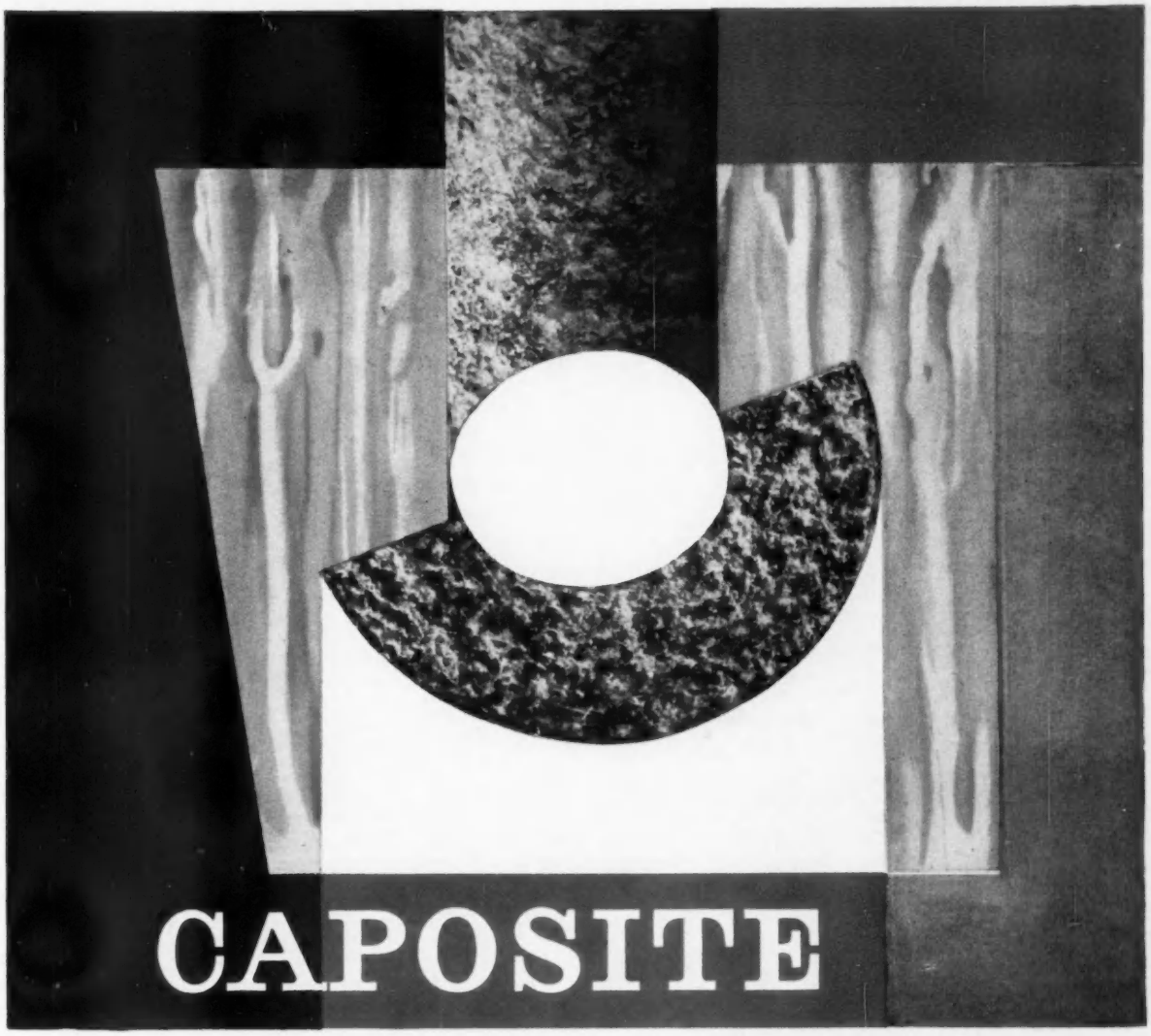

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'efficient, economical'

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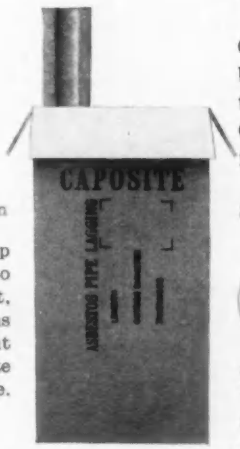

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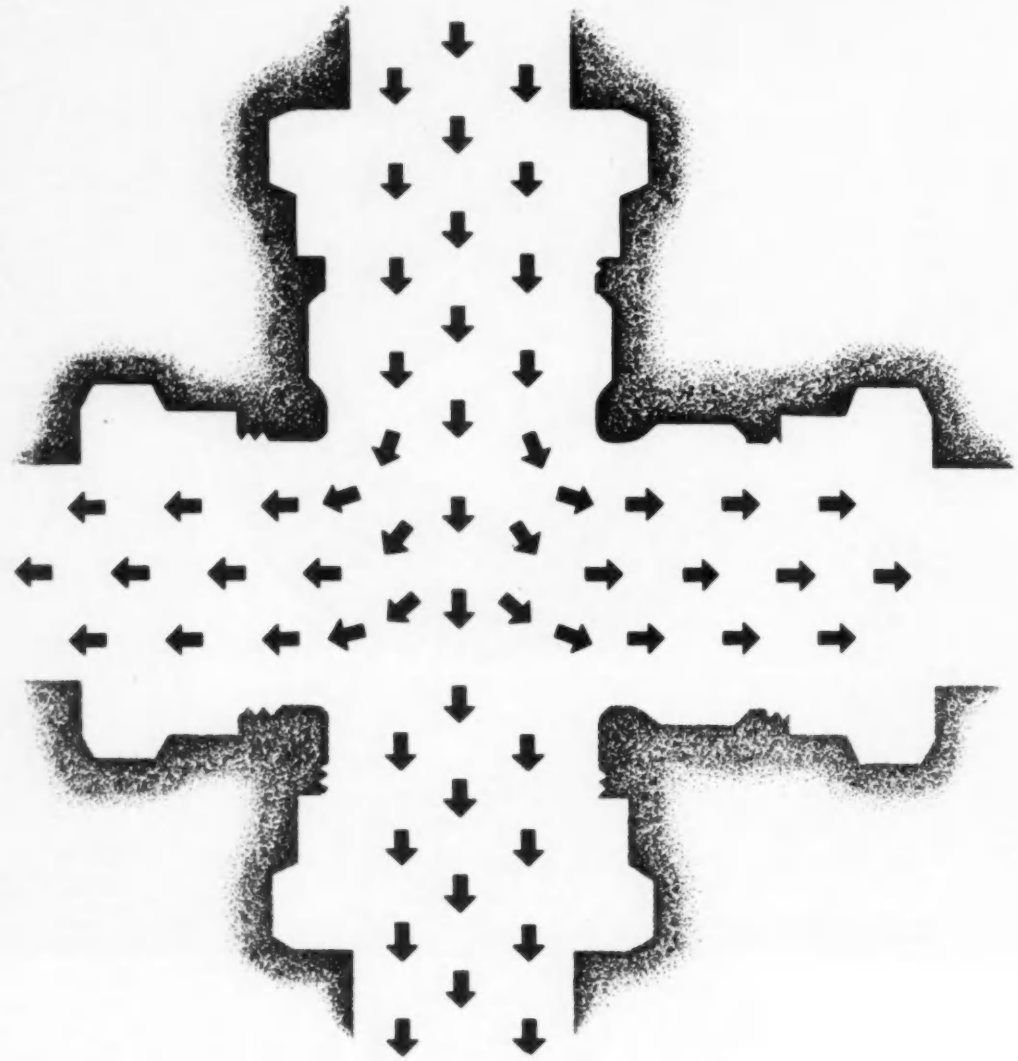

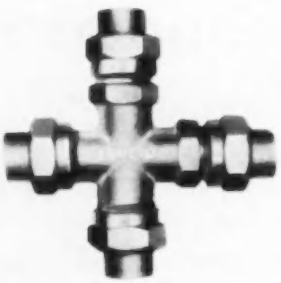

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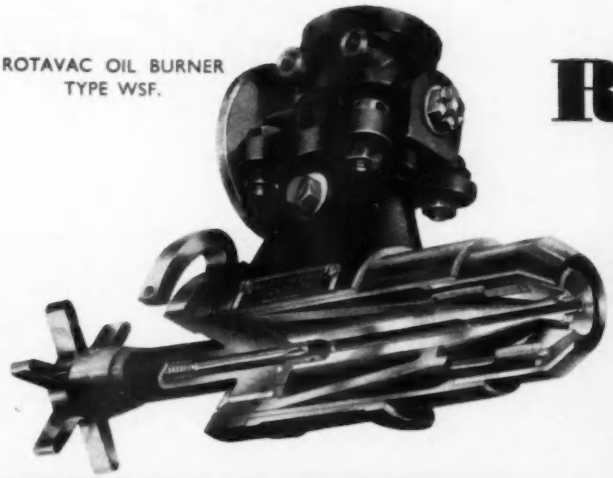

ROTAVAC OIL BURNER
TYPE WSF.

ROTAVAC
–makes boilers give their best

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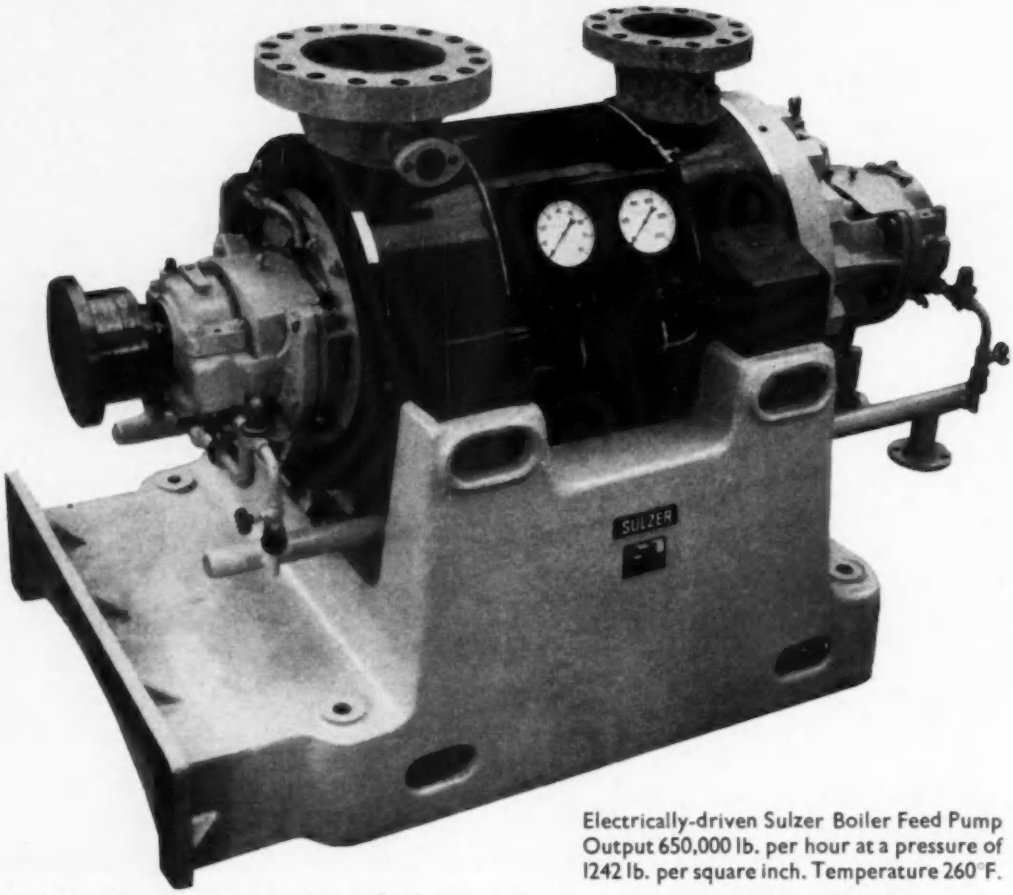
SULZER
BOILER - FEED PUMPS



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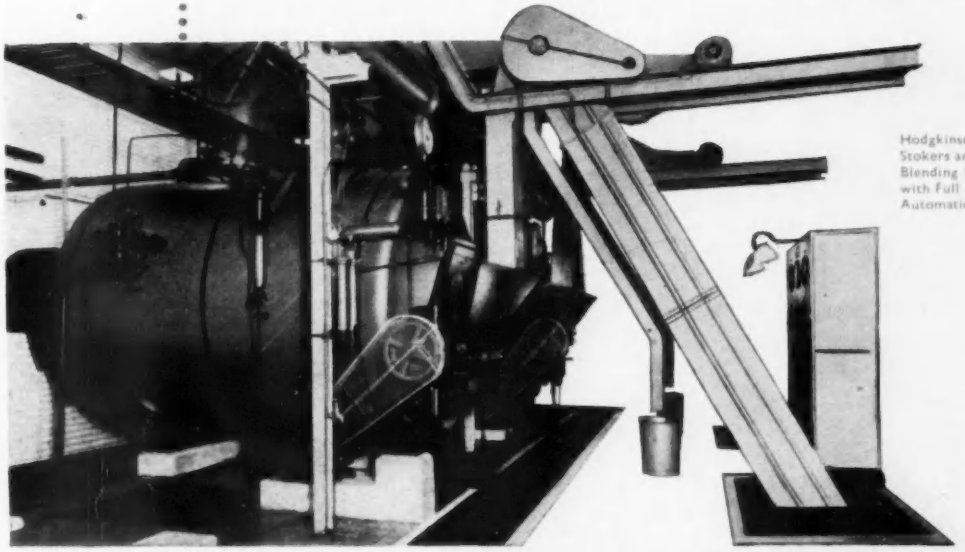

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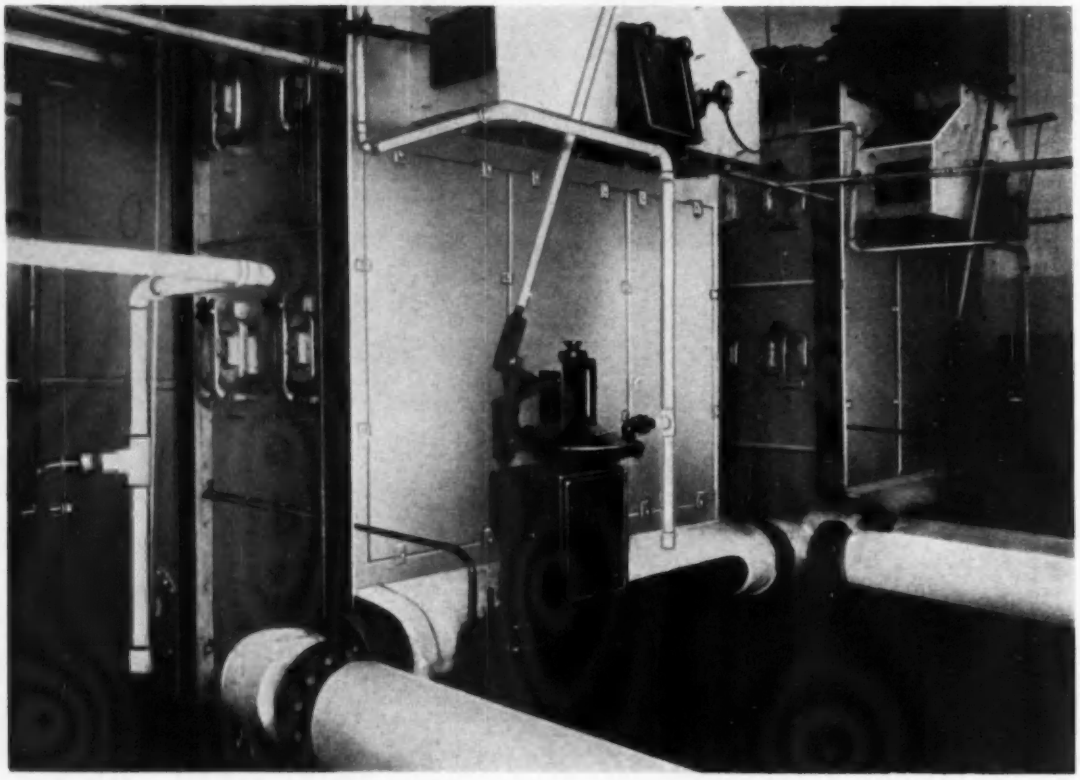

(By courtesy of the Air Ministry.)

Hall rear view of two 7-million B.Th.U's/hr. BSF type H.P.H.W. packaged boilers.

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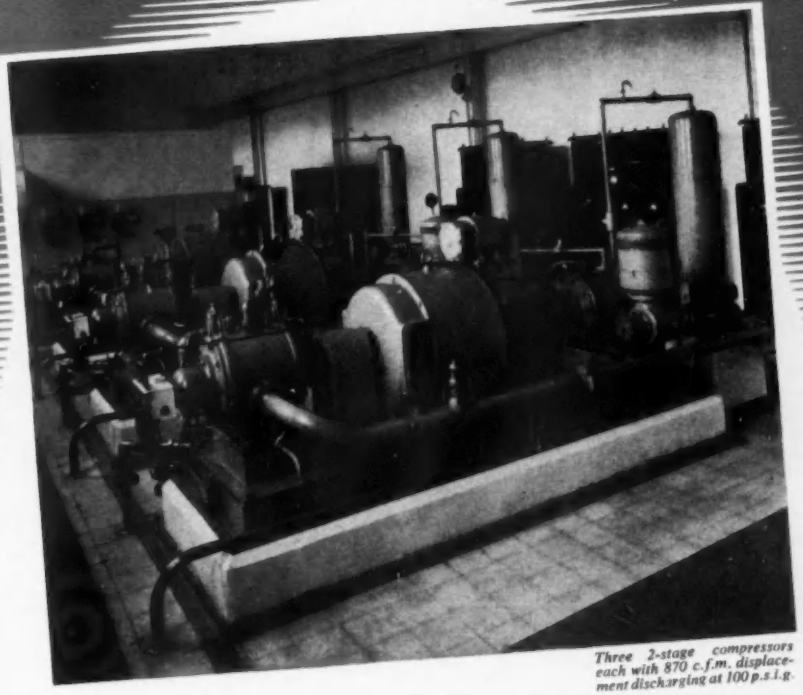

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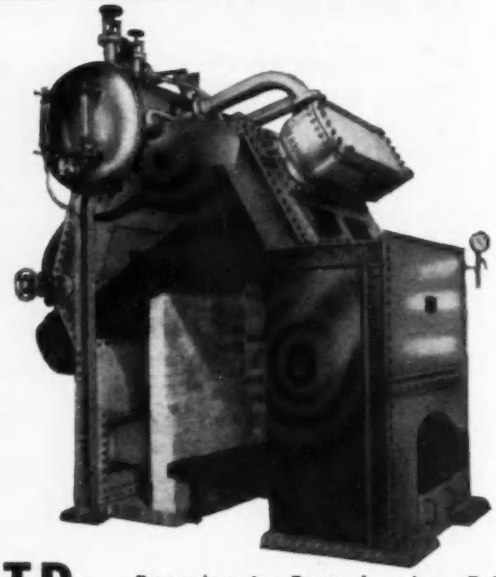

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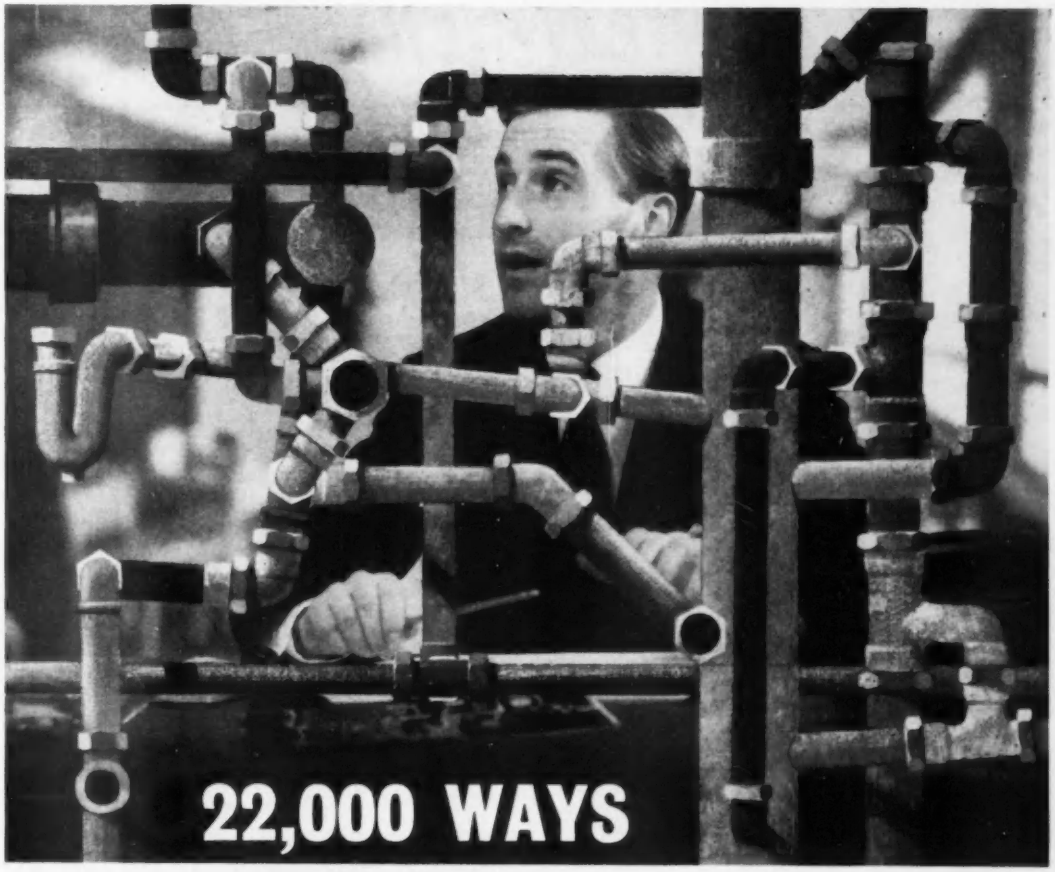

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Whatever the job, whatever the problem, call for KONTITE pipe fittings and set your mind at rest. There are over 22,000 different types and sizes of KONTITE compression fittings—the largest range in the world. 22,000 ways of solving your problem perfectly. KONTITE joints are easily made at the turn of a spanner, they save time, labour, and costs. KONTITE fittings are made in gunmetal to resist corrosion for all sizes of pipe up to 6 in. bore. Kay's make a point of speedy service. Whatever fittings you need can be delivered within days—most items by return. Write for fully illustrated catalogue of KONTITE fittings.

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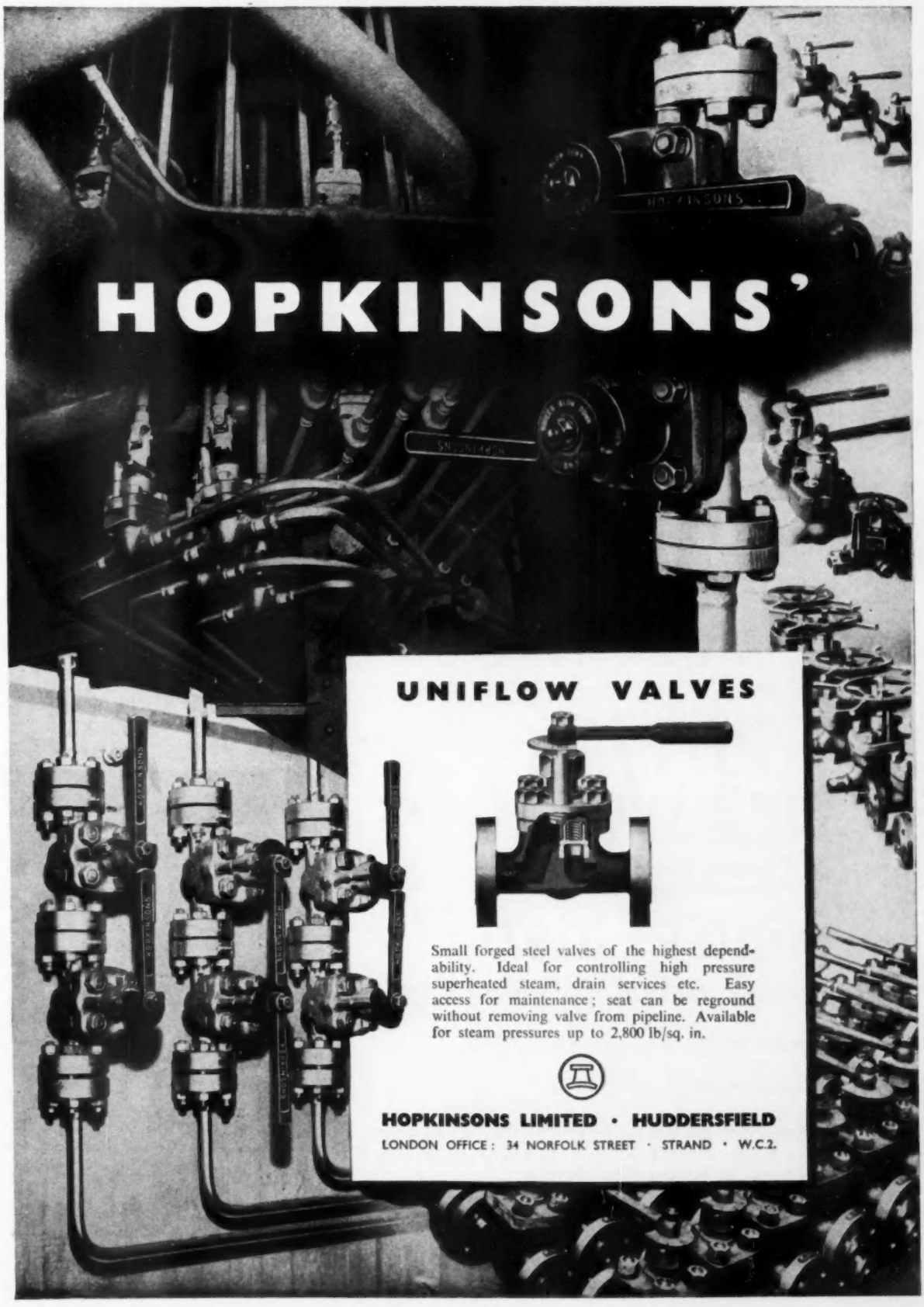
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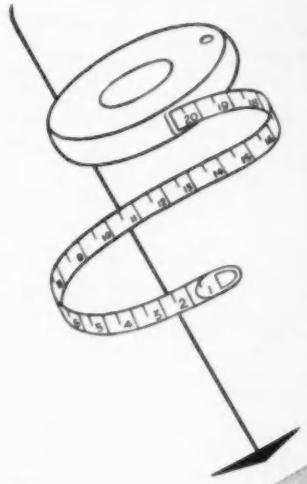

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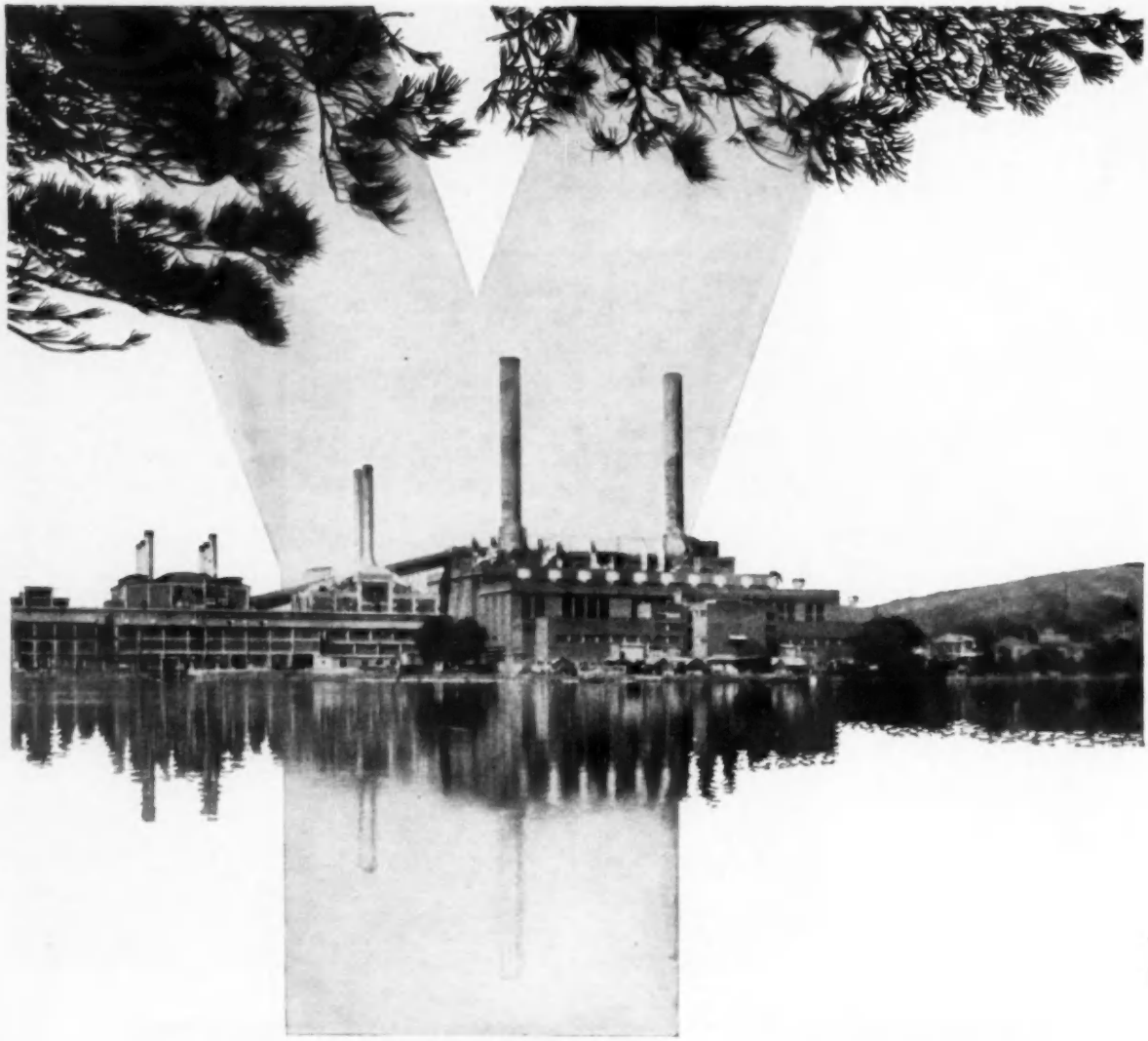

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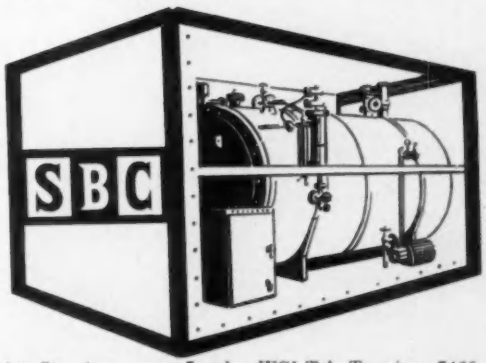

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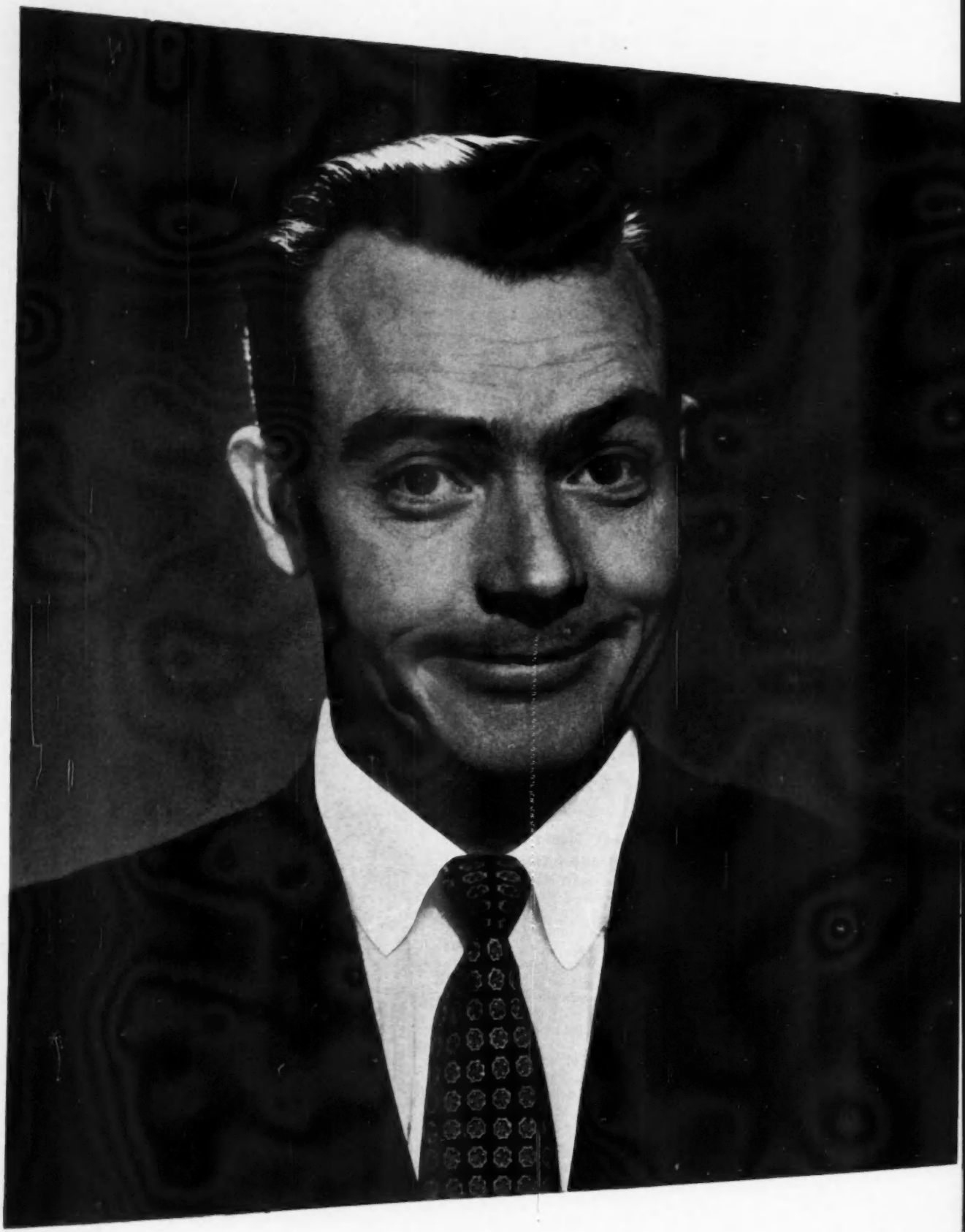

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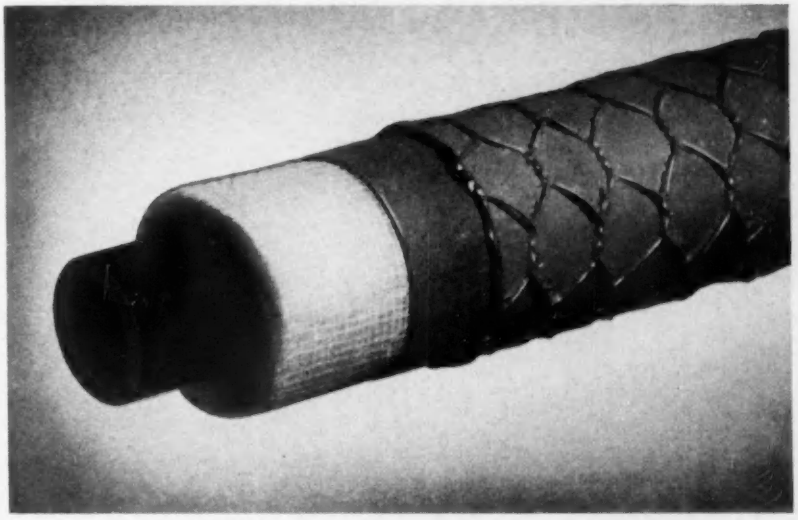

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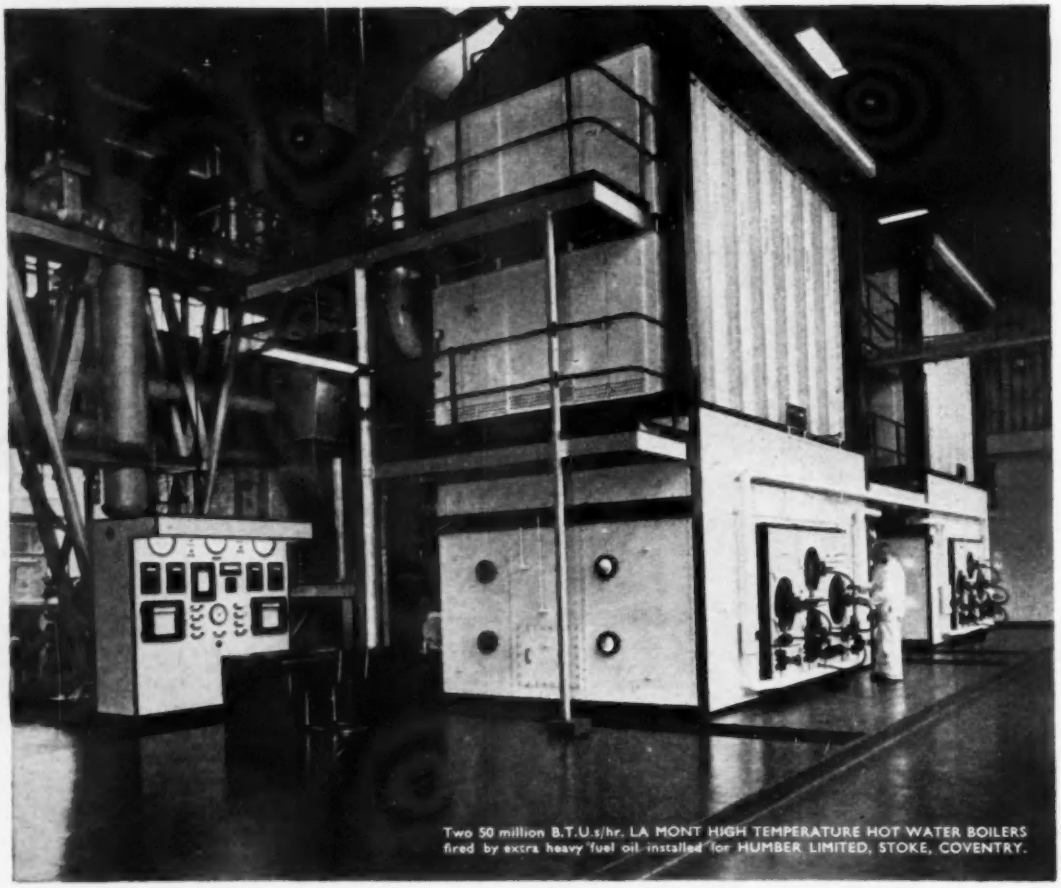

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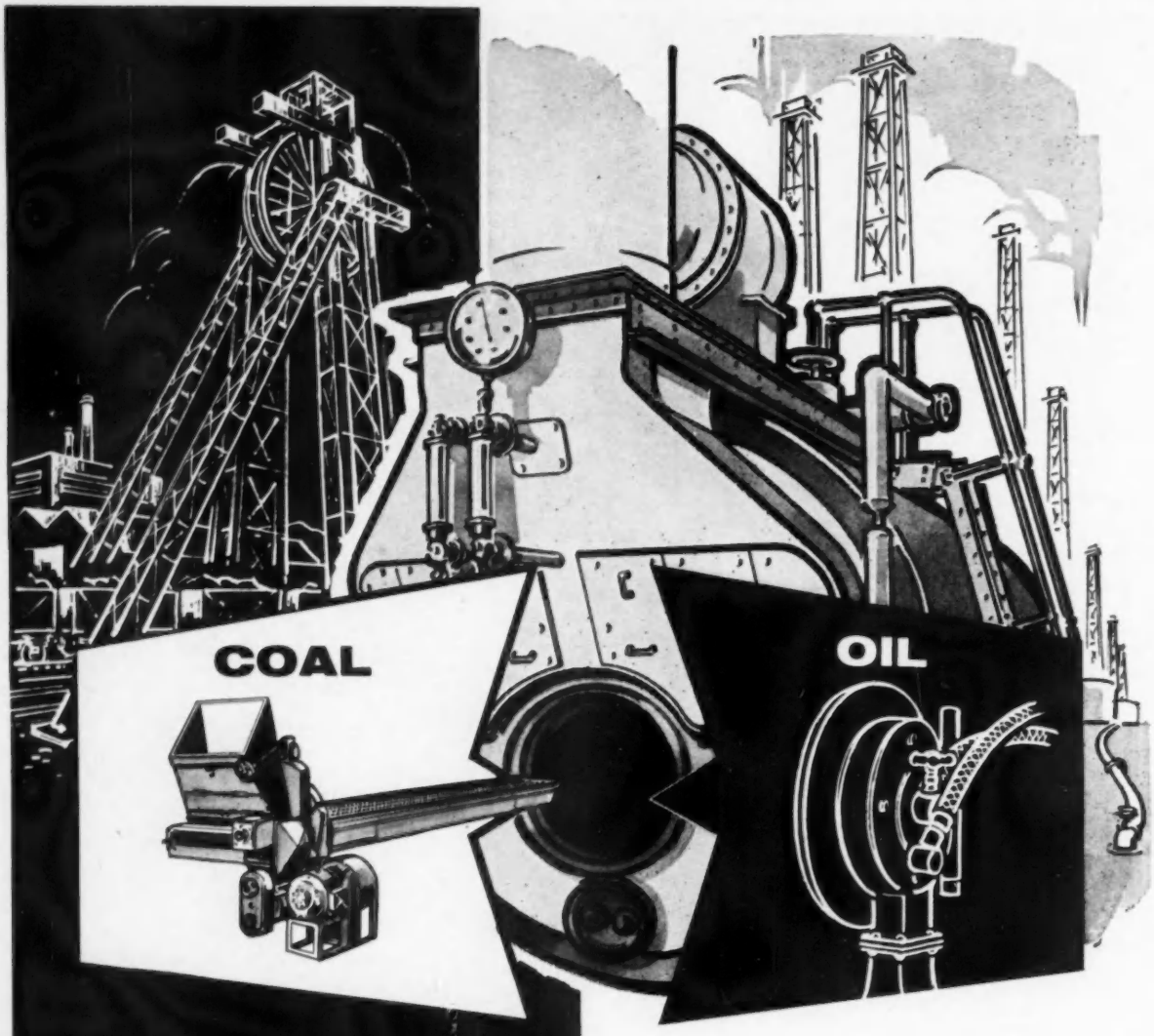

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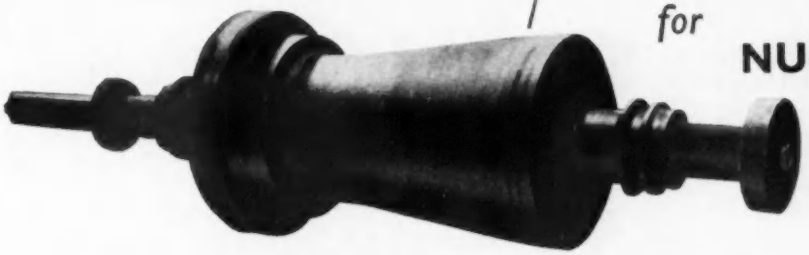

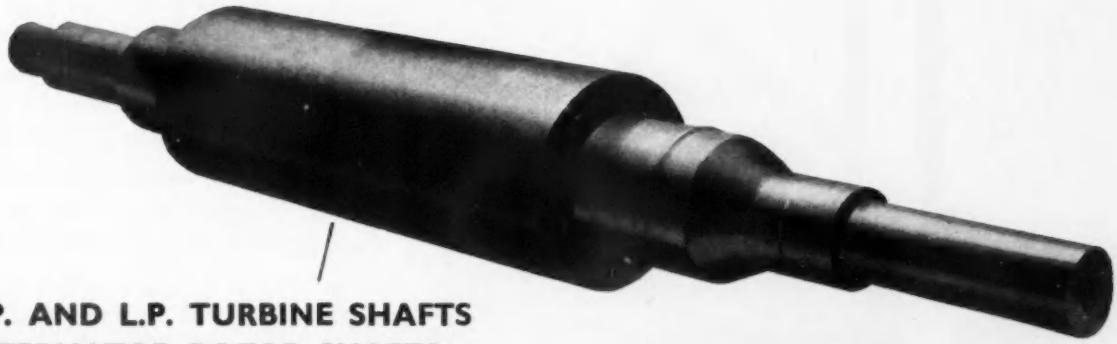

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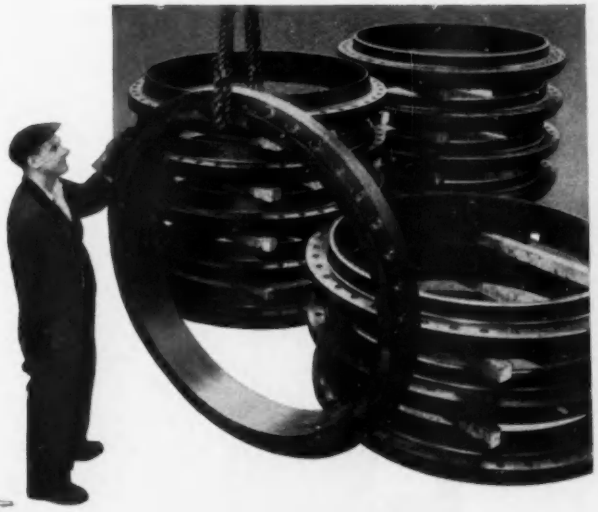

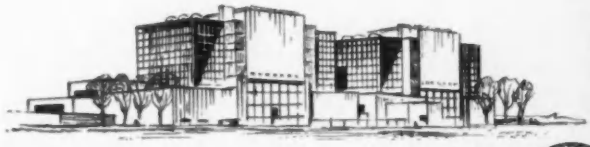

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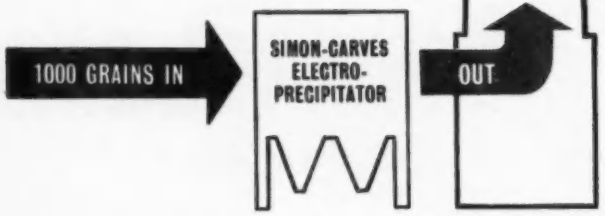
FLEETWOOD	No. 2	25 GRAINS	6·4 GRAINS
FLEETWOOD	No. 3	25 GRAINS	2·7 GRAINS
HACKNEY 'B'	No. 3	15 GRAINS	9·2 GRAINS
ROGERSTONE	No. 2	25 GRAINS	4·4 GRAINS



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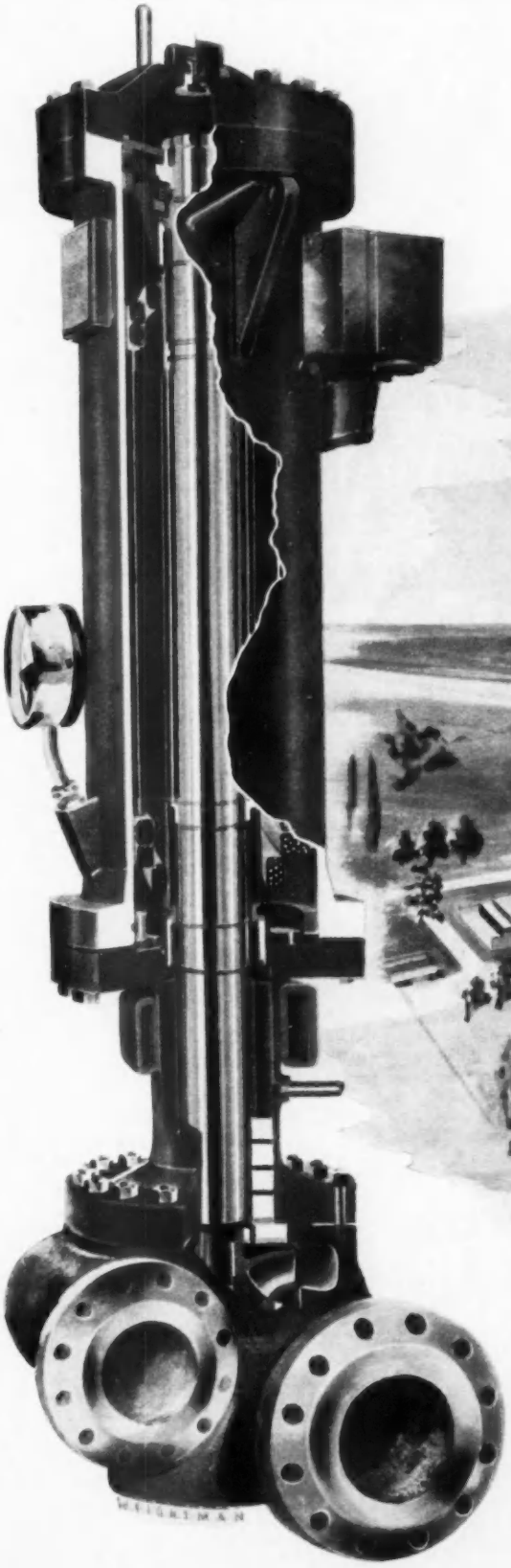

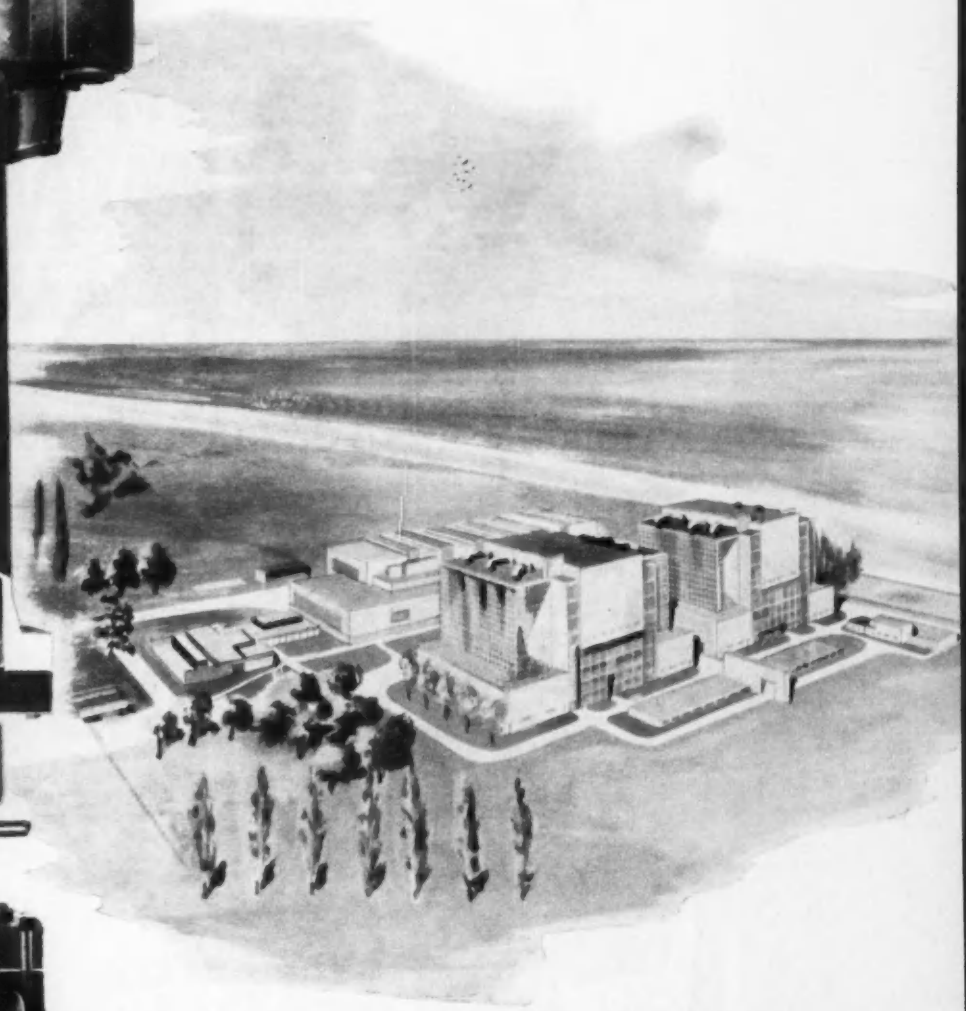

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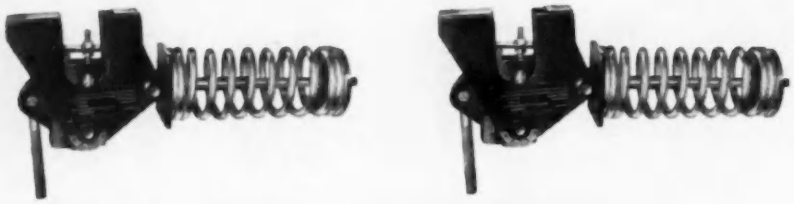

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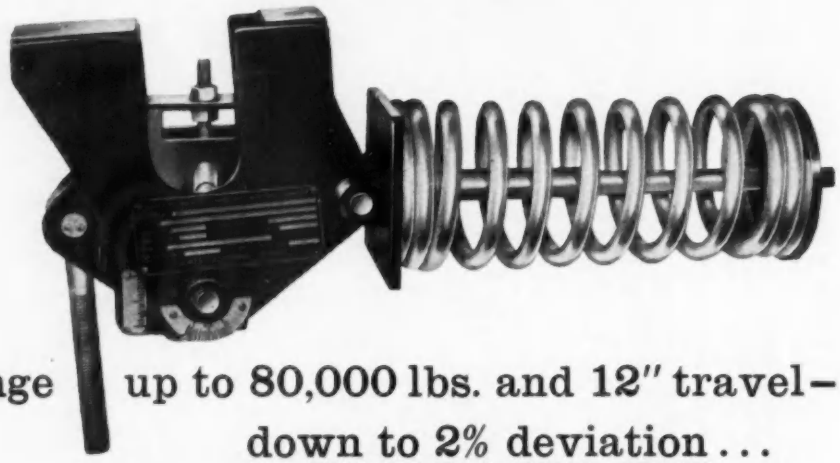

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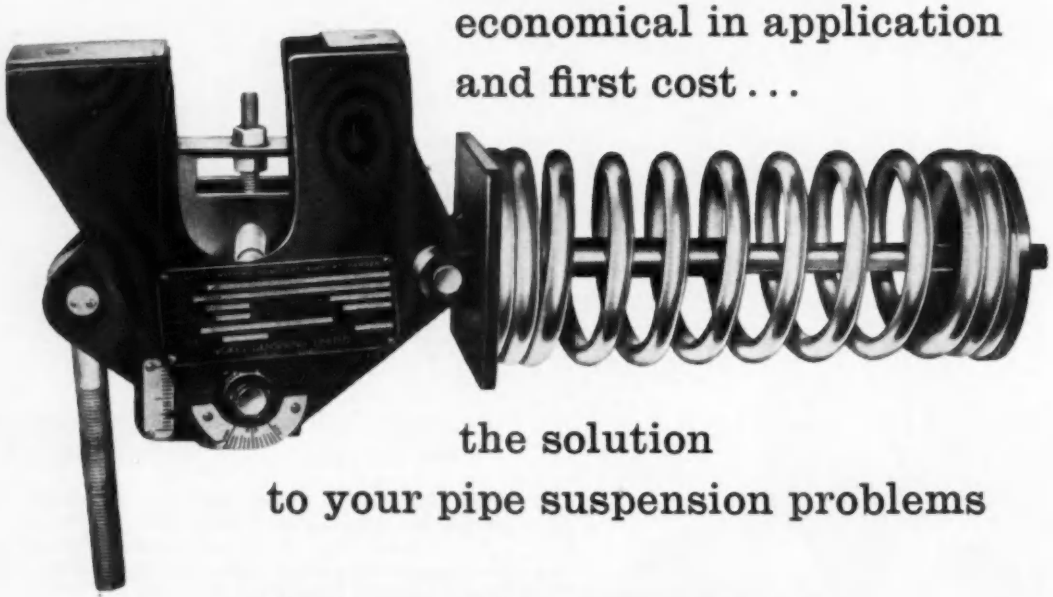

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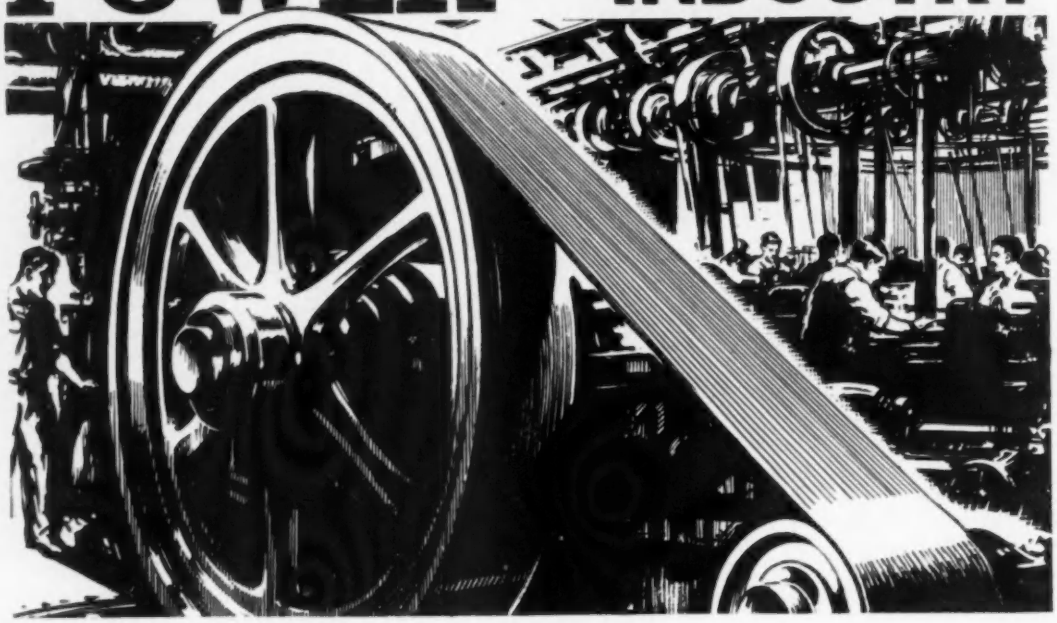

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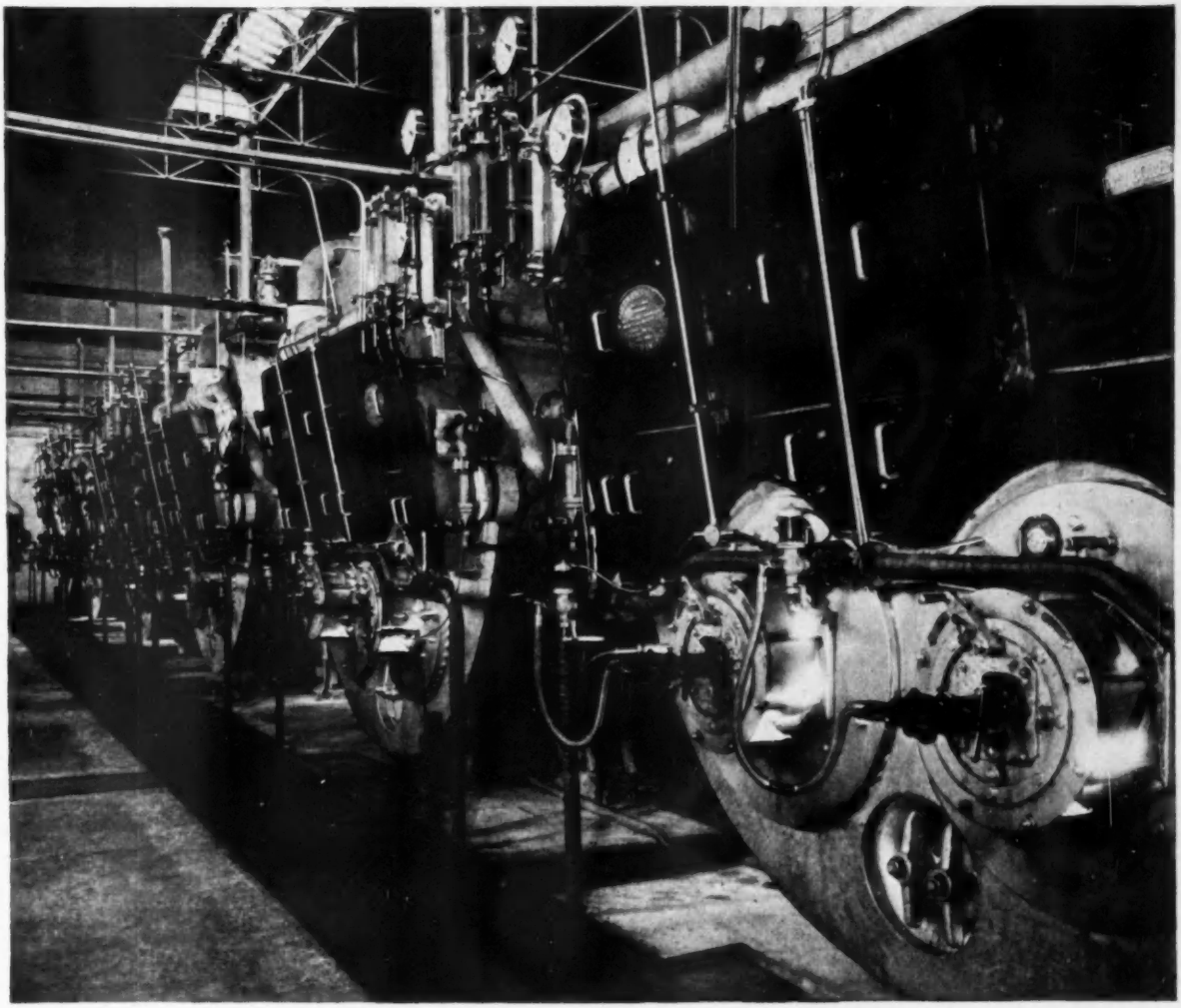

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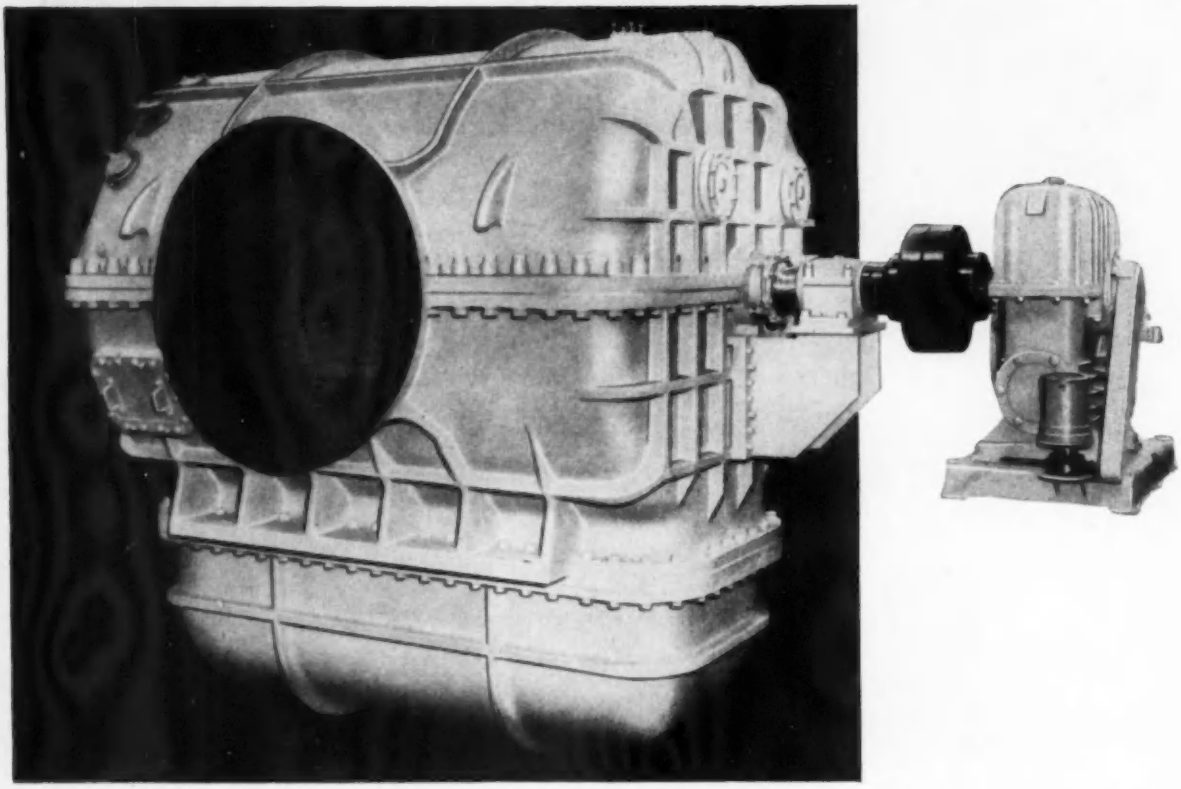

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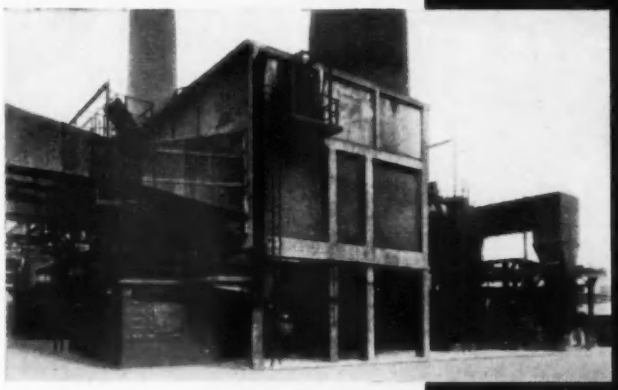
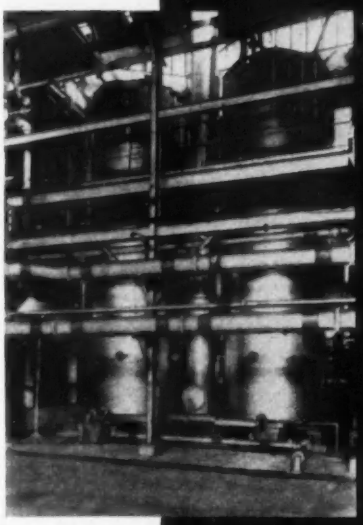


FLY-ASH INSTALLATIONS

One of the four three-section Holmes-Elex Electrical Precipitators installed after the pulverised fuel fired boilers at the Billingham Works of Imperial Chemical Industries Limited.

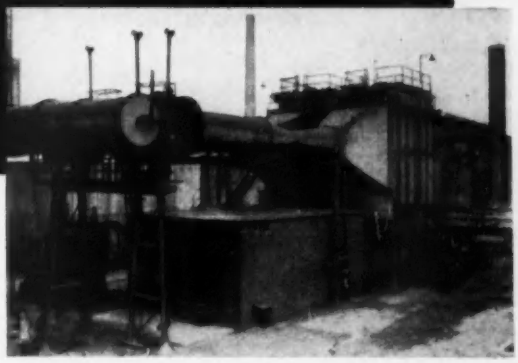


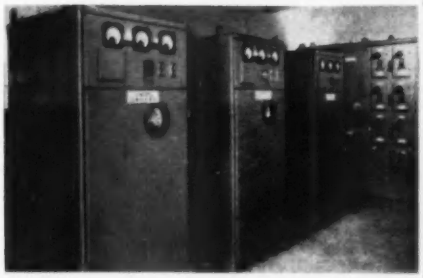
CHEMICAL INDUSTRY

Holmes-Elex Electrical Precipitators removing acid mist fumes resulting from the manufacture of sulphuric acid at the Trafford Park Works, Manchester, of Messrs. Courtaulds Limited.

IRON & STEIL INDUSTRY

A two-section Holmes-Elex Electrical Precipitator installed for the final cleaning of blast furnace gas at the Scunthorpe Works of the Appleby-Frodingham Steel Company (Branch of the United Steel Companies Limited).





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Gas Cleaning Division,
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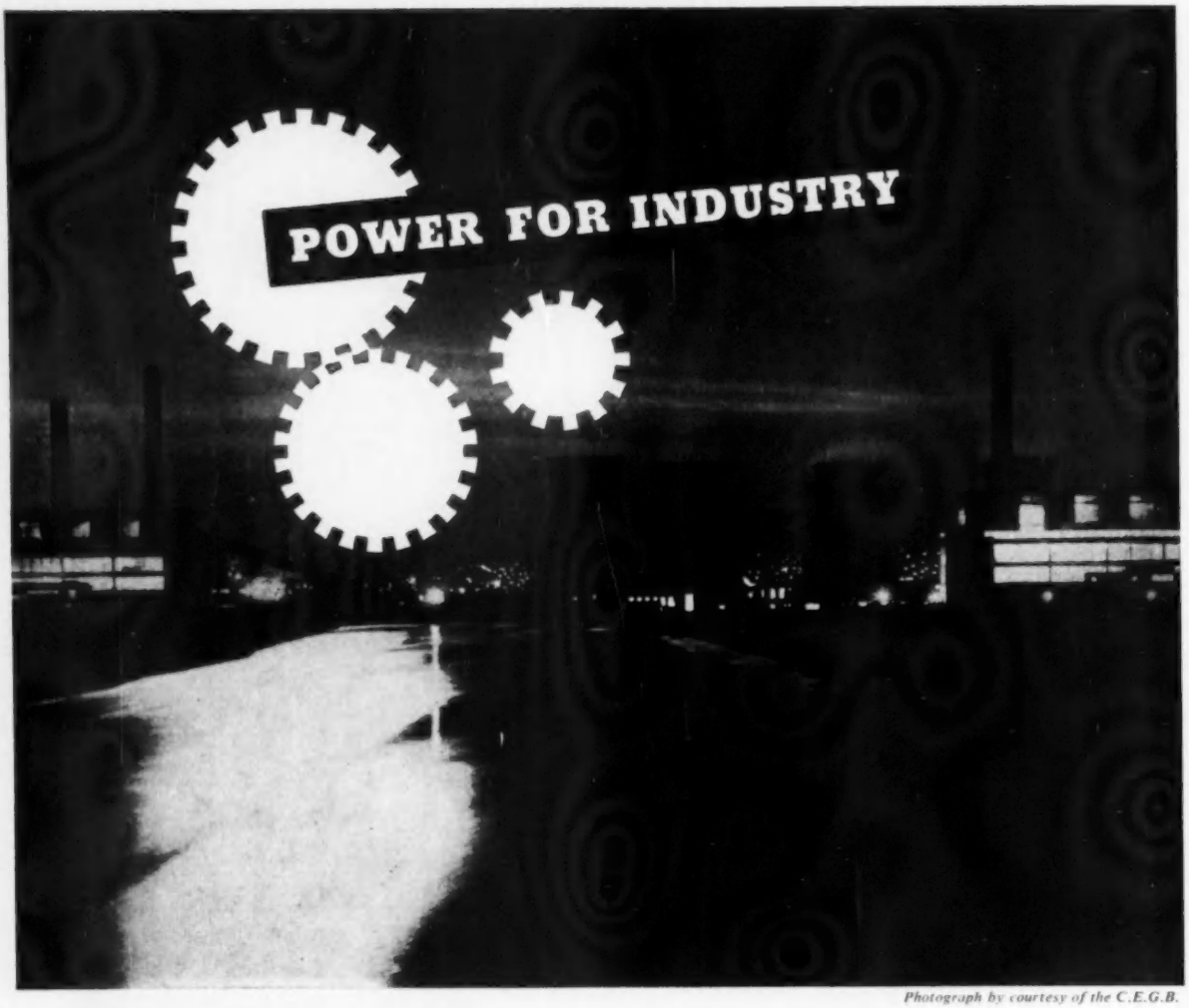

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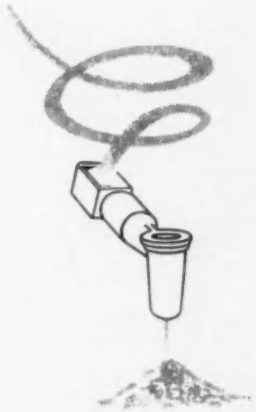

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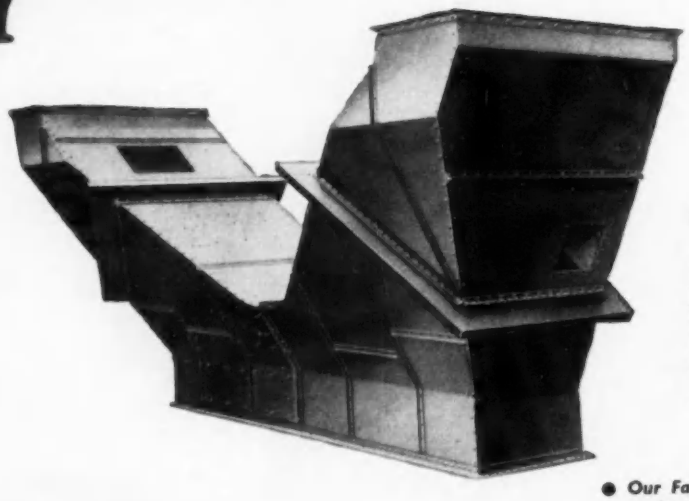

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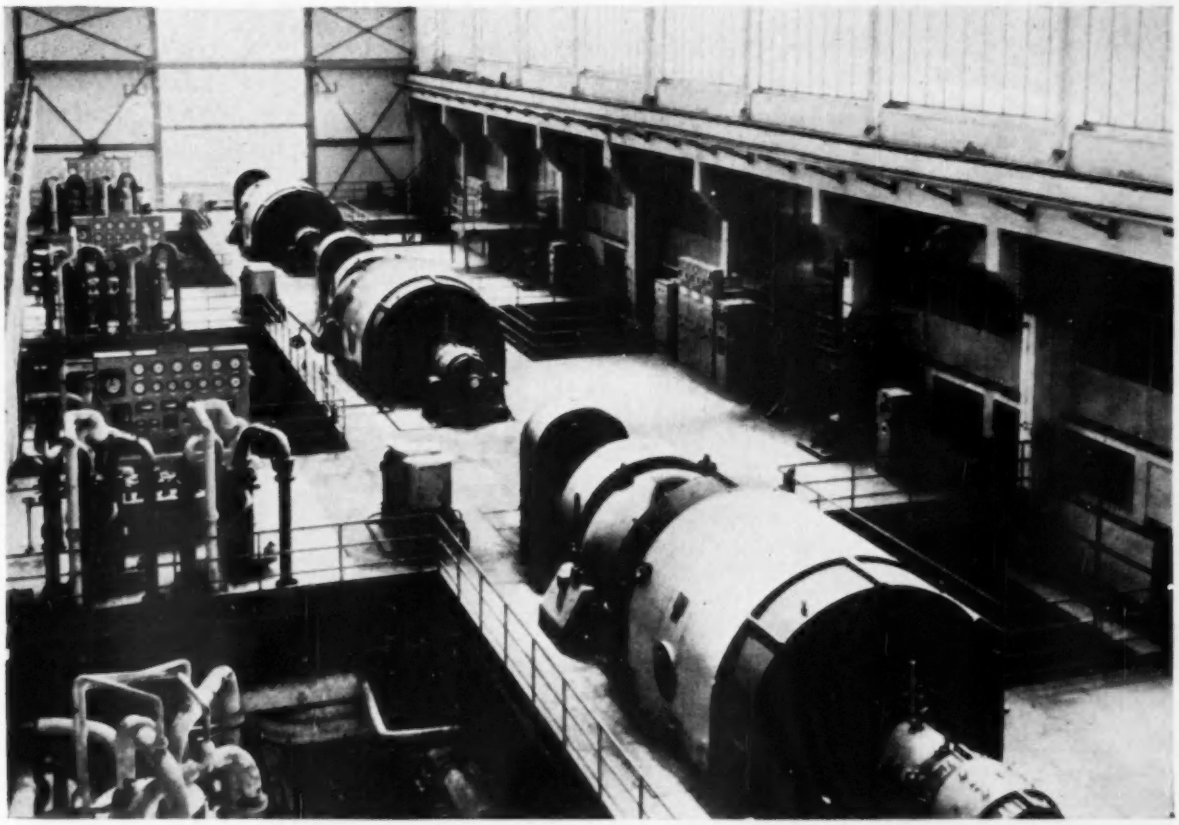

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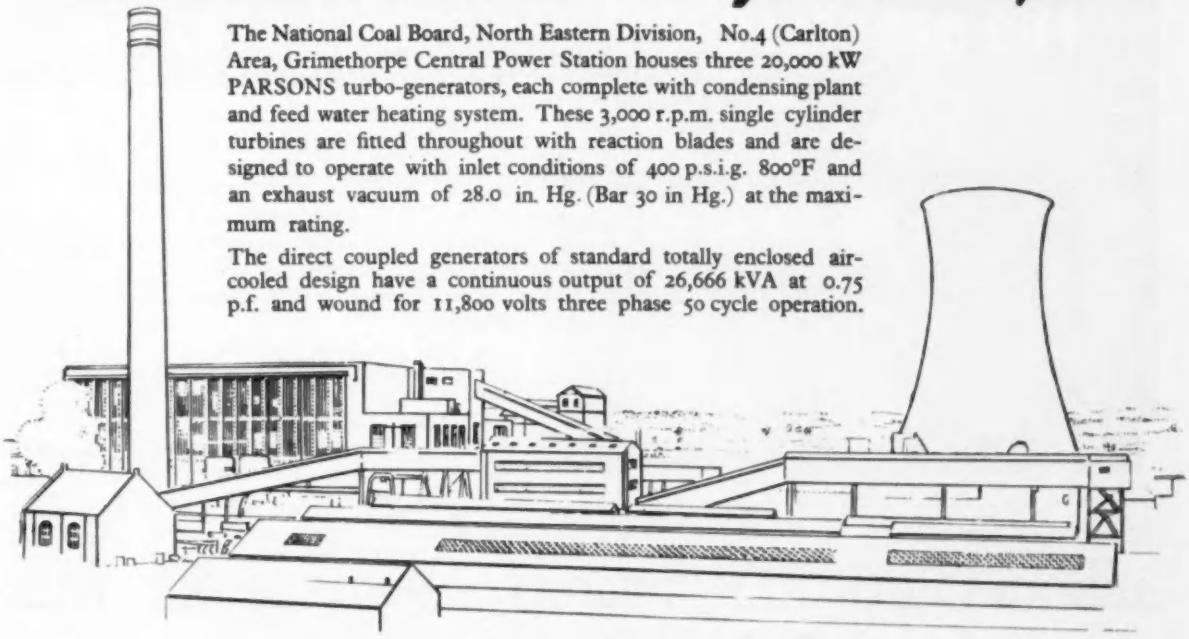
The National Coal Board, North Eastern Division, No.4 (Carlton) Area, Grimethorpe Central Power Station houses three 20,000 kW PARSONS turbo-generators, each complete with condensing plant and feed water heating system. These 3,000 r.p.m. single cylinder turbines are fitted throughout with reaction blades and are designed to operate with inlet conditions of 400 p.s.i.g. 800°F and an exhaust vacuum of 28.0 in. Hg. (Bar 30 in Hg.) at the maximum rating.

The direct coupled generators of standard totally enclosed air-cooled design have a continuous output of 26,666 kVA at 0.75 p.f. and wound for 11,800 volts three phase 50 cycle operation.



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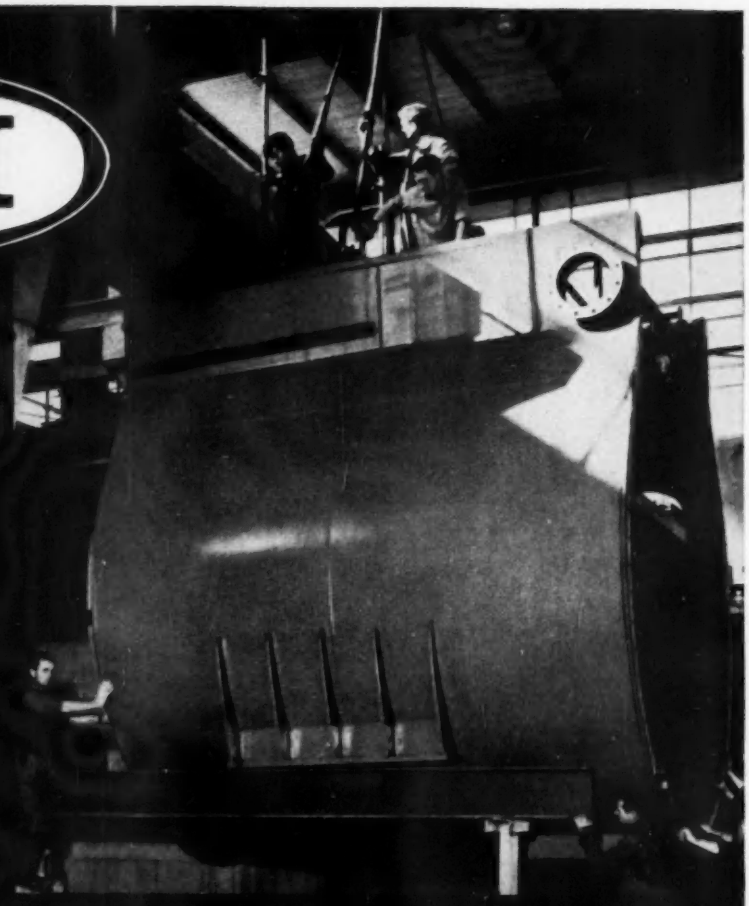
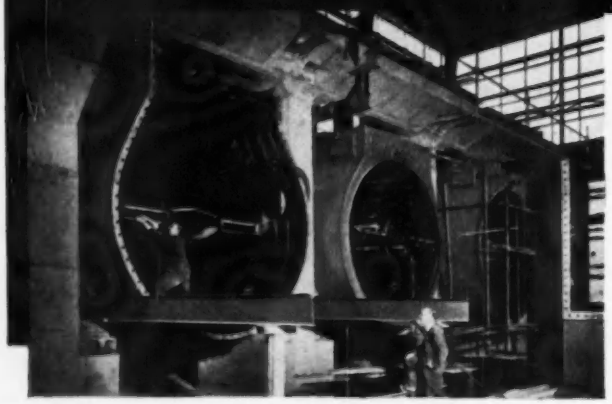


One unit of a three-shell surface condenser being placed in position at Berkeley, the commercial nuclear power station now under construction in Gloucestershire by the A.E.I.—John Thompson Nuclear Energy Company.

FOR BERKELEY NUCLEAR POWER STATION



A general view of three condenser shells in position at Berkeley.

The entire turbine-house heat exchange equipment for the new power station at Berkeley is being supplied by the A.E.I. Turbine-Generator Division, and manufactured at their factory at Germiston Glasgow.

Four three-shell main condensers — one for each of the four 83 MW mixed-pressure steam turbine-generators also being supplied by A.E.I.

Two-stage feedwater heating equipment for each turbine-generator.

Two 'dumped' steam condensers to handle surplus steam generated when commissioning the reactors, or in the event of a sudden shut down.

Other equipment in manufacture includes the steam jet air ejectors, water/water heat exchangers for the generator cooling circuit and general gas circulator service, oil coolers and generator hydrogen cooler units.

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

AUGUST 1959

VOLUME 74. No. 8

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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An outstanding installation of

OIL-FIRED *industrial* BOILER PLANT

The covered firing-aisle showing the boiler fronts with their fuel-oil firing equipment.

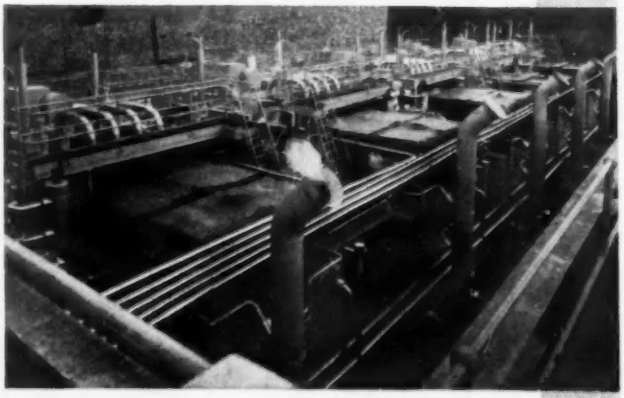
The illustrations show the fine new installation of Babcock oil-fired Bi-drum boilers supplying steam for power-generation and processing, through back-pressure turbo-alternators, in the Stork Margarine Works of Van den Berghs and Jurgens Ltd., Purfleet.

The five boilers, each rated at 36,000 lb./hr. M.C.R., at 425 lb./sq.in., 680°F, are of the "outdoor" type, with only the firing-aisle, control equipment and auxiliaries under cover, so eliminating the capital cost of a boiler-house. Oil-firing is by means of 'Y-jet' wide-range steam-atomizing burners, of which there are 3 per boiler, using 3,000-seconds fuel-oil.

The whole of the fuel-oil pumping-and-heating plant and most of the high and low pressure pipework also were designed, manufactured and installed by Babcock & Wilcox.

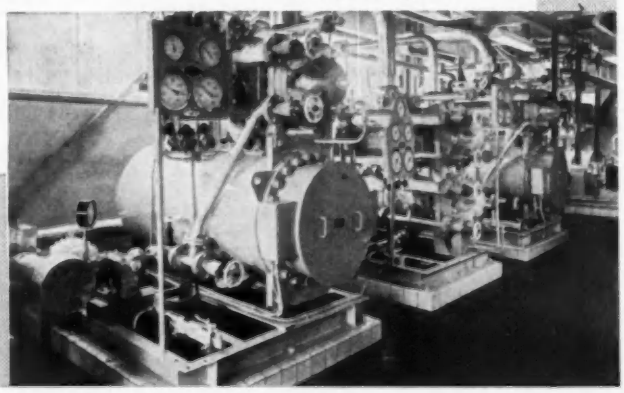
This boiler plant replaces a previous Babcock installation which had served this factory well for over 40 years.

(Consulting Engineers: Merz & McLellan).



(Above) The "outdoor" installation of five Babcock Bi-drum boilers.

(Below) Babcock fuel-oil pumping and heating units in the pump-bay serving the boiler plant.



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Engineering and BOILER HOUSE REVIEW

AUGUST 1959

VOLUME 74 No. 8

NUCLEAR CONTRACTS

SEVERAL rather gloomy and outspoken comments have been made during recent weeks by the chairmen and leading executives of some of the companies engaged in the design and manufacture of nuclear power plant and associated equipment, regarding the fact that too little return is forthcoming for the efforts and capital already expended by the consortia on research and development. The number and volume of nuclear power station contracts may be too small to support the manufacturing facilities which have been established.

In this country, owing to the increased output capacity of the larger nuclear stations now being ordered, only about five or six at most will be needed to complete the present programme, and with the establishment of a fifth consortia, it appears that there will be insufficient business to keep all five fully occupied.

This outlook was emphasised by Mr. Richard Miles, chairman, Head Wrightson & Co. Ltd., in his address at the annual general meeting of the company recently, when he said "I see no reason to depart from my warning two years ago, and repeated last year, that to pioneer builders of nuclear power stations, reasonable profits will rarely accrue. There are now too many Groups chasing too little work. This is not in the national interest at a time when there is a shortage of scientists and technologists."

Likewise, Mr. H. G. Nelson, managing director of the English Electric Co. Ltd., when speaking at the official opening on July 24th of the company's new Atomic Power Centre at Whetstone, said that the volume of nuclear power station business may be too small to support the facilities which have been established. This was partly due to the fact that the availability of oil and coal as fuels is much more secure, and because the rapid growth in size and efficiency of both conventional and atomic stations reduces the number that needs to be constructed to meet the country's power demands. Mr. Nelson also said that it now seemed that it will be longer than anticipated, before atomic energy can compete economically with other forms of power. For these reasons, the export market might be slower to develop than was at first thought. We had at one time great hopes that an export market would open up before us, but it has proved very competitive. The whole situation is, Mr. Nelson said, a difficult one which is giving rise to serious concern. Under the circumstances, competition between the groups, instead of being the healthy stimulus it has been in the past, is in danger of becoming an aggravation of a very acute position.

These sentiments were echoed by Mr. R. B. Potter, chairman of Simon-Carves Limited, at that company's annual general meeting, when he said he was concerned at the spending of exceptional sums on research and development, with no real assurance of proper continuity of work in the future. Mr. Potter also made reference to the export problem, and said that there is no evidence that foreign countries are ready to place orders regularly with this country. Indeed, in Europe, there are indications that a number of contracts will go to America, apparently because of the more attractive terms which are being offered both for credit and sale/re-purchase of reactor fuel elements.

Sir Leslie Gamage, M.C., chairman and managing director of The General Electric Co. Ltd., also emphasised, in his annual review and accounts for 1958-59, on July 18th, the difficulties with which builders of nuclear power stations are now faced. Whether such contracts are likely to show anything resembling a profit is difficult to foresee, and the G.E.C. have come to the conclusion that " there is only a limited market for the present form of gas-cooled graphite-moderated reactor overseas, owing to its high capital cost. An intensive new approach to reactor dimensions and electrical capacity is necessary to reduce capital cost."

In any case, there is every indication that the value of the individual contracts will probably be reduced as technological developments lead to advances and more compactness in design. So what is to be done ? Some of the various companies would, it appears, like to break away from the present arrangements and take their chances in a system of tendering for the separate plant requirements of a nuclear station. They, or at least the groups, are certainly calling for a considerable cut in expenditure. It has even been said that the whole consortia system may possibly be replaced in the not too distant future.

Close collaboration between consortia is also being discussed, and, in fact, negotiations have been in progress for some weeks between Nuclear Power Plant Co. Ltd. (N.P.P.C.) and the A.E.I.-John Thompson Nuclear Energy Co. Ltd., with a view to arranging collaboration between the two companies in nuclear matters, and it has been decided that collaboration shall take place. The two companies have informed the chairman of the Central Electricity Generating Board of this decision, and negotiations are continuing with a view to settling details. It is the immediate intention of the two companies to submit a joint tender for Dungeness Power Station, based on a common design, and a similar procedure will, in due course, be followed for Sizewell Power Station, in East Anglia.

Points and Pointers

ATOM SCHOOL FOR BUSINESS MEN The second course in 1959 on the uses of radioisotopes, specially planned to suit the needs of company directors and senior executives, will be held at Harwell from September 29th to October 2nd, and is open to any interested director or senior company official. During 1957/58, nearly 350 company directors and senior executives went to Harwell on four-day courses to acquire knowledge concerning the possibilities of using radioisotopes in their businesses. During this time they were given, in as non-technical a manner as possible, an overall picture of how isotopes can be used, what sort of research is being carried out on further possible uses, and generally, how isotopes can be of economic benefit to industry. The introduction of radioisotope techniques into a factory can increase the efficiency of certain operations, can cut out waste by the continuous automatic monitoring of a fast process, or provide research workers with a "new tool" in most cases far more sensitive than ordinary physical or chemical methods. These courses are primarily for persons who have had no training whatever in radioactivity, and are intended to stimulate ideas rather than to teach techniques. The courses are invaluable as a meeting ground on which U.K.A.E.A. research workers can make contact with industrialists who have their own special problems to be solved. The informal discussions between staff and delegates are an important part of the courses, and delegates are put in touch with specialists regarding any particular problems on which they would like information regarding the possibility of using isotopes. Included in the course are lectures on the hazards of using radioactive materials, and the simple precautions required. Visits are paid to research reactors and other places of interest in the establishment, also to the Wantage Radiation Laboratories, where research is being carried out on the possibilities of using the large sources of radiations for a variety of purposes. Delegates are accommodated at an Oxford college for four nights, and conveyed daily to Harwell by coach. The fee for the course, inclusive of all accommodation, meals, transport and lectures, is £40, payable in advance. Applications are accepted strictly in rotation, and application forms are obtainable from the Registrar, Isotope School, Harwell, Berkshire.

TRAWSFYNYDD NUCLEAR POWER STATION Elsewhere in this issue we publish some technical and contractural details concerning the Trawsfynydd Nuclear Power Station Project, for which a letter of intent was issued recently by the Central Electricity Generating Board, to Atomic Power Constructions Limited. Work on the station has already commenced, and the plant is scheduled to be in operation by 1964. Thus, five British consortia are now engaged in constructing the first five nuclear power stations in this country to be designed purely for electricity generation. Two of the consortia (The Nuclear Power Plant Co. Ltd. and the G.E.C.-Simon-Carves group) will also be engaged in building nuclear power stations overseas—one in Italy and one in Japan. A main point of interest concerning this new 500-MW station is that it will be very closely linked as an operational unit, by a 275-kV overhead transmission line, with the pumped-storage hydro-electric scheme at Blaenau Ffestiniog, about five miles away. The hydro plant, which is designed for an output of 300-MW (four 75-MW generating and pumping sets), and a pumping input of about 400,000 h.p., will help to provide an off-peak load to give the nearby Trawsfynydd station a high load factor, without which, the output would be uneconomic. It has been estimated that the hydro station will be supplying peak loads, mainly during the winter months for about 4½ hr. a day, on five working days per week, and that the pump will be run for about 6½ hr. on each of the five nights. When the two stations are fully operational, the joint scheme will provide the world's first full-scale tests for joint operation between pumped storage and nuclear power. Although the reactors for Trawsfynydd are essentially based on the Calder Hall design, and in general terms are similar to those for the civil stations being constructed by the other consortia, some improvements in design have been made since the contracts for the other stations were placed. For example, although the output is the same as at Hinkley Point, the internal diameter of the reactor pressure vessel is 5 ft. 6 in. smaller. This has been made possible by upgrading the operating pressure to 240 lb./sq. in.—which is now almost 2½ times that at Calder Hall.

A.E.I. REORGANISATION A somewhat vast re-organisation, or divisionalisation, scheme has recently been put into operation by Associated Electrical Industries Limited. Lord Chandos, A.E.I.'s chairman, formally announced this divisionalisation a few weeks ago, and said that the main purpose of the scheme was "to meet the intensely competitive conditions within the electrical manufacturing industry." It will help to eliminate overlapping by companies within the group in matters of research and re-equipment. It is also likely to foster a more single-minded approach to the development and marketing of the group's products. The new product divisions, which began trading on July 1st, are—Motor and Control Gear; Switchgear; Transformer; Electronic Apparatus; Traction; S.E.S. Cables; and S.E.S. Telecommunications. The Turbine-Generator and Heavy Plant Divisions were formed a year ago, and further divisions will be formed in due course. A new company—Associated Electrical Industries Export Limited—has taken over from the separate export companies of British Thomson-Houston, Metropolitan-Vickers and Siemens Edison Swan, and is now responsible for the overseas selling organisations for these companies and the product divisions. In Canada a new A.E.I. company has been formed to take over the

selling activities previously conducted there by the three individual subsidiary companies, and similar A.E.I. companies are being formed in New Zealand, South and Central Africa, and Brazil. In the United Kingdom, 23 A.E.I. district offices have replaced the branch offices of British Thomson-Houston, Metropolitan-Vickers and Ferguson Pailin, and they are controlled by seven regional managers.

SUMMER SCHOOL ON CORROSION

For the sixth year in succession, a week is being devoted to the study of corrosion and the various means of its prevention, at the Metallurgy Department of the Battersea College of Technology, London, S.W.11, from September 29th to October 2nd. This somewhat unusual series of four-day courses was started in 1954 when three lecturers were invited to deal with the fundamental principles of corrosion and its prevention; 80 people attended. The following year, with 45 people present, seven visiting lecturers spoke on the numerous aspects of the oxidation of metals. In 1956, no less than eight lecturers were invited to address 80 people concerning various aspects of water treatment. The following year there were again eight visiting lecturers when 50 people attended to hear about corrosion testing and research methods. Last year, still another eight lecturers spoke to an attendance of 80 at a course on underground corrosion and cathodic protection. This year's lectures will deal with newer materials—metallic and non-metallic, for resistance to aqueous and high temperature corrosion. The topics included are of special interest to engineers, namely, design in corrosion, nickel alloys, stainless steels, titanium, zirconium, tantalum, precious metals, plastics and coatings of plastics, fibreglass, paints and so on. More especially, this course should be of help to those engineers, metallurgists, chemical engineers and corrosionists who wish to obtain up-to-date information of developments at first-hand from experts in these fields. The fee for the course, including lunch and refreshments, is 12 guineas and application to attend should be addressed to the Secretary (Summer School), Battersea College of Technology, Battersea Park Road, London, S.W.11.

U.K.A.E.A. INFORMATION CENTRE

An information centre has been opened at the London office of the United Kingdom Atomic Energy Authority. Its purpose is to provide a convenient centre in London where members of the public, commercial firms and other organizations may consult published unclassified material (that is, with no security restrictions), and seek advice on sources of information on United Kingdom Atomic Energy matters. A collection of U.K.A.E.A. unclassified reports is available for reference, while indices and abstracts of atomic energy literature are filed, and publications about the work of the United Kingdom Atomic Energy Authority are also available. The centre forms part of the public relations branch of the Authority. The facilities which it offers are complementary to the already well-established information services provided by the Authority at Harwell, Risley and, to a limited extent, Aldermaston, for dealing with scientific and technical inquiries. Next to the centre is a photographic library which holds a collection of some 8,000 photographs covering many aspects of atomic energy. Prints may be purchased from the stock or ordered to suit particular requirements. The library also holds stocks of slides in both colour and black and white, which are available on loan. The information centre and the photographic library are open from Mondays to Fridays inclusive, between 9.30 a.m. and 5 p.m. The address is: United Kingdom Atomic Energy Authority, 11, Charles II Street, London, S.W.1.

SCOTTISH FIRM'S ADVANCE IN STEEL TECHNOLOGY

Modern industrial processes obviously call for many new ideas; and in numerous industries, including chemical and nuclear engineering, there is an increasing demand for corrosion-resistant structural materials. Since the war, the famous Scottish steelmakers, Colvilles Limited, have developed a new range of clad steels—known as "Colclad"—which gives this protection at a comparatively low cost. It is probably a major step forward in steel-making technology, and the firm's idea to bond high-quality stainless-steel to carbon or low alloy steel has succeeded. But not without considerable difficulties before the "break through." Research on the subject commenced just after the war, the first task being to study the actual requirements of such a material, and the sort of conditions under which it would be used. It was clear that in most cases only one surface of a fabricating plate would need to be corrosion-resistant, and therefore it was calculated that a thin "skin" of stainless-steel or nickel would give the necessary protection, while the cheaper carbon-steel would provide the strength. In the case of nickel, the bonding process was comparatively easy, as it has only to be hot-rolled in contact with mild-steel to obtain adhesion. With stainless-steels or any chromium-bearing alloy, however, the problem was more complex; the surface of these alloys has a film of chromium oxide about one molecule thick, yet sufficient to prevent bonding. Therefore, before any stainless-steel cladding could be produced, this film would have to be removed or eliminated. An extensive study of the problem, about which there is a considerable amount of scientific literature, revealed many ingenious though too often impracticable methods of breaking down this invisible barrier. The research team at Colville's Motherwell laboratories experimented by depositing a layer of mild-steel on to a stainless-steel surface by electric arc welding. It was necessary, however, to use a welding technique which provided the minimum penetration of the stainless-steel. After numerous tests, a suitable technique was evolved. This new method, which is patented, requires fabrication and rolling techniques of a special character. A continuous bond is obtained, and bend tests with the cladding in tension and compression have shown no sign of separation. In fact, it is reported to be possible to twist the material through 360 deg. and untwist it without causing any break in the bond. Colvilles, one of 16 firms participating in the D.S.I.R. Stand at the Scottish Industries Exhibition in Glasgow (September 3rd-19th), are showing samples of this material as well as examples of another recent development—Ducol W.30—a low-carbon, low-alloy steel combining qualities of high strength and ease in welding.

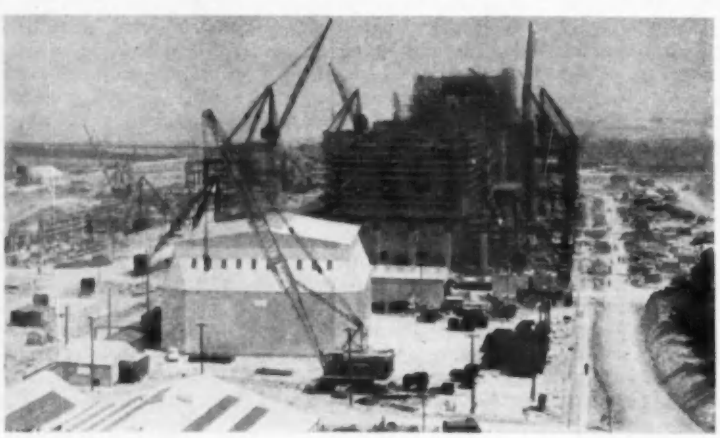
Progress at Hinkley Point

RECENTLY we had the opportunity of paying another visit to Hinkley Point, the world's first 500-MW nuclear power station, now under construction for the Central Electricity Generating Board by the English Electric-Babcock & Wilcox-Taylor Woodrow Atomic Power Group.

It was in September, 1957, that the order was placed with the Group for the construction of the station. In the project, the consortium was responsible for the nuclear design, for supplying the main electrical generating plant and associated auxiliary equipment, for the design and construction of the reactor pressure vessel, the steam-raising equipment, and for the entire civil engineering works of the station. In addition, Babcock & Wilcox Limited, undertook the design and construction of the Goliath crane, a unique structure claimed to be the largest of its type in the world, and which will be used to speed up construction work by lifting into position complete steam-raising unit shells and prefabricated sections of the reactor pressure-vessel.

The station is due for completion in 1962—construction work at the present time being well up to schedule. Most of the civil engineering work has been completed—a major contribution in this connection being the installation on June 20th by Taylor Woodrow Construction Limited, at a point 2,000-ft. off-shore, of the cooling-water intake caisson, a 90-ft. dia. by 60-ft. high cylinder through which sea-water will flow at the rate of 35 million gal./hr. into the station through under-water pipelines. The caisson, which is an intricate structure of reinforced-concrete construction and which weighs 3,900 tons is supported on the sea-bed on eight 68-ft. long, 4-ft. 0-in. dia., adjustable steel "spud legs"—a technique believed to be unique in power station construction work.

The success of the towing into position of the caisson depended on very accurate timing. The tides only allowed a four-hour period of sufficient depth of water to launch the caisson, tow it to its final position and ground it. Such a tight schedule included many hazards, unpredictable weather being the foremost. The operation was carried out by the combined crews of Taylor Woodrow Construction Limited, and their towing contractors, Metal Industries (Salvage) Limited, Helensburgh. After consideration of an elaborate system of weather forecasts and site recording instruments, the decision to move the caisson from its construction dock was made at the latest possible time. The caisson was winched northwards by the Metal Industries' boom defence vessel through a carefully-prepared dredged channel of limited depth and width in the rocky foreshore. Once outside the dredged channel, the tow was taken up by an ocean-going tug, through the surveyed and buoyed channel into deeper water, before turning east to make the "run in" over the sinking zone. Final positioning was by "winching" on the caisson's own winches to more precise directions given by radio from shore-based instruments, and was carried out to the exact requirements dictated by the line and position of the tunnels already driven to a point in close proximity to the caisson. Having achieved a satisfactory location in conditions of strong and variable currents and a rapidly falling tide of 35-ft. range, the caisson was grounded on its eight "spud legs," extended to pre-determined lengths based on accurate sea-bed surveys. On achieving maximum loading and level conditions, the main flooding valves were opened to render the caisson tidal, and the effort was completed some eight hours after leaving the construction dock. The final work was to construct an aerial ropeway which will carry materials and personnel 2,000 ft. over the channel to the caisson. Work began on this as soon as the caisson was grounded. Around the caisson as it was towed, was a sheet-pile "crinoline," which, when driven into the sea bed, will form the cofferdam within which connections to the cooling-water tunnels will be constructed. These 12-ft. dia. tunnels are more than half completed, and driving is rapidly reducing the remaining distance at the rate of 100 ft./week.



Since construction started in December 1957, considerable progress has been made at this 500-MW nuclear power station. The illustration is a view of the site from the top of the 400-ton lifting capacity, Goliath crane.

General site progress

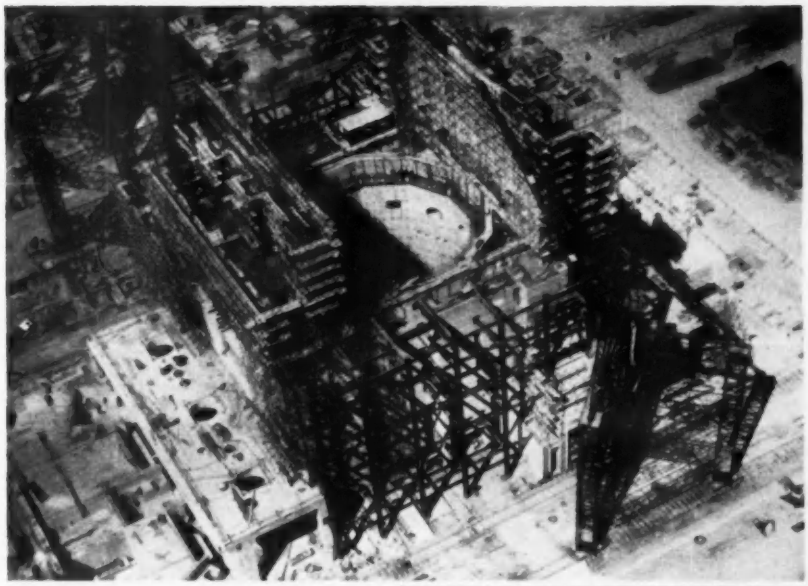
Civil engineering and structural work has now reached an advanced stage; the 100-ft. high main biological shield of the first reactor was completed last year and the shield for the second reactor is now more than 80 per cent. complete. Construction of the turbine-house basement is proceeding and the erection of the steel superstructure

has commenced. Some 100,000 cu. yd. of rock had to be excavated before construction work on the turbine house basement could be commenced. The site for the pumphouse was excavated to a depth of 80-ft., the foundations have been completed, and concreting of the floor and walls is now in progress. The outfall, designed to convey the cooling-water back to the Bristol Channel, is also substantially complete.

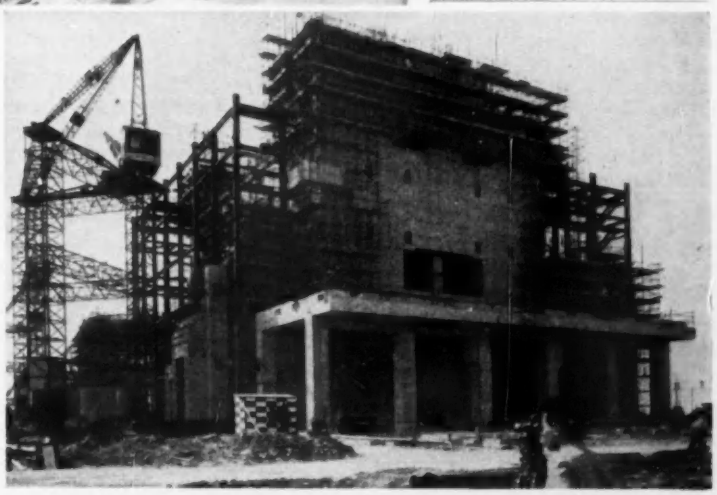
Reactor pressure vessels and steam-raising units

Work is now well advanced on the site pre-fabrication of the 67-ft. dia. spherical pressure-vessel to contain the graphite core for No. 1 reactor. The vessel is made from 3-in.-thick mild-steel plates formed at the Renfrew works of Babcock & Wilcox Limited, each course of plates being pre-assembled on jigs in order to check shape and alignment.

After this check assembly, groups of several plates are fully welded at the works into assemblies suitable for transport to site (by sea and road via the Port of Combwich, some four miles from Hinkley Point). To reduce as far as possible the amount of welding to be done at site within the reactor biological shield, the plate assemblies as received from the works are built into complete circumferential courses in the site-fabrication shop, with the result that less than half of the vessel fabrication will be carried out *in-situ*, within the biological shield. The plates forming the first course are set up on jigs, being held together and aligned by wedge clamps. The size of each plate as received from the works allows for the welding contraction so that when the complete course of plates is set up with the correct welding gaps, the diameter of the course after welding will be within the permitted tolerance. When the course plates have been assembled, the joints between them are manually welded in a carefully programmed sequence to assist in maintaining circularity. After welding is completed the weld surface is prepared for examination, and the joint X-rayed. When the first course is finished, the skirt and second course plates are matched to it and welded similarly into complete rings. Then the welds between the skirt and first course, and between the first and second courses are made and the bottom cap welded to the first course, thus completing a section of the vessel which can be lifted into the biological shield.



(Left). Aerial view of the completed biological shield of No. 1 reactor, showing, also, the foundation plinth for three of the six steam-raising units.



(Below). Close-up of structure of No. 1 reactor building showing biological shield, plinth for steam-raising units, and steelwork for control room.

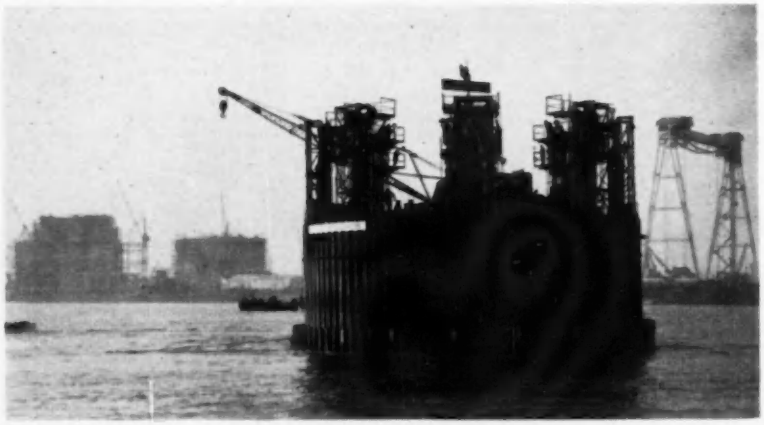
Before removing this section (which includes the 6-ft. dia. gas-inlet apertures of the pressure-vessel) from the area, the plates of the third course will be assembled in place on the second course and matched to it. The vertical seams of the third course will then be welded.

This procedure will be followed for all the pre-fabrication work, each course being matched to the previous one before the latter is lifted away to its position in the biological shield. The pressure vessel will be supported on the external cylindrical skirt and welded to it, and the bottom of the skirt will rest on structural steel members above the concrete foundation. The graphite structure itself will be supported on a grid, the weight being transmitted to the external skirt by an internal skirt which supports the grid. The hot gas will leave the top of the shell through six large circular openings and there will be six similar inlet openings in the bottom for the return of the cooled gas.

Steam-raising units

The shell of the first of the twelve 90-ft. high units, each weighing well over 300 tons, has been completed and, following X-ray examination of the circumferential welds now being carried out, the shell will undergo hydraulic test preparatory to being moved and positioned on its foundation plinth alongside No. 1 reactor building. The fabrication of the second and third steam-raising units is now well advanced. The procedure adopted for the fabrication of these units is similar to that developed and applied by Babcock & Wilcox in their construction of all the steam-raising units at the Calder Hall and Chapelcross stations. The sub-assemblies for each shell in the form of six ring-sections complete with all thermal sleeves, and two domed ends, were manufactured at the company's Dalmuir works and shipped to site by sea via Combwich. At site, the sections are assembled in sequence on rail trolleys and taken into the fabrication shop. When welding is completed, the weld surface is prepared for examination and the joint X-rayed. When the six sections of the shell are welded together, the top and bottom heads are fitted, and finally the supporting skirt. After each seam is completed it is stress relieved, using high-frequency induction heating equipment. On completion, the shell is drawn into the hydraulic test area, all duct and access openings having previously been carefully sealed. The vessel is then filled with water and subjected to a test pressure of 308 lb./sq. in. After hydraulic test the shell is drained and the interior cleaned by vacu-blast equipment. During this work a stream of clean dry air from a drying unit is drawn continuously through the shell by fan so that there is no possibility of condensation on the clean surfaces.

After stress-relieving, hydraulic test and sealing operations are completed, each shell is ready for placing in position on its prepared foundations, there being six steam-raising units per reactor, placed three on each side of the reactor building. The internal components and fittings will be installed subsequently, under the strictest " clean-room " conditions ; the complete units will then each have a total weight of some 1,250 tons.



Cooling-water intake caisson nearing its final position 2,000 ft. offshore.

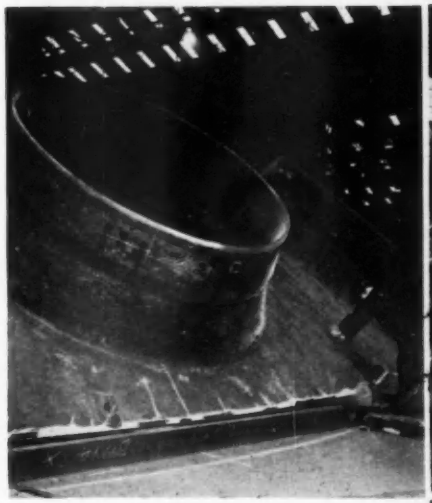
The Goliath crane

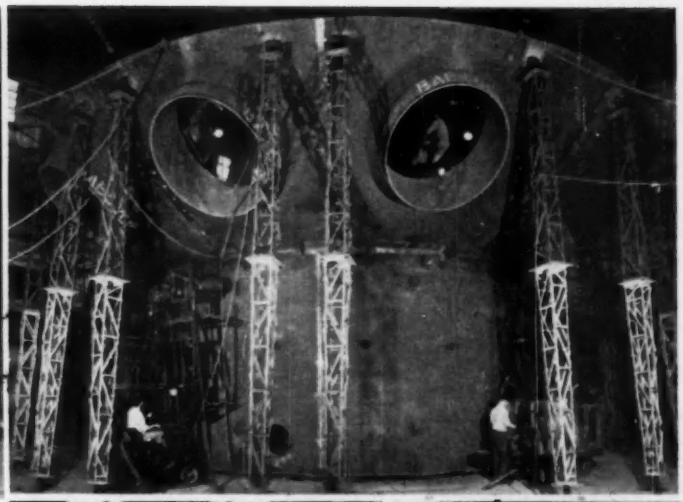
In previous issues of this journal we have made reference to the Goliath crane which Babcock & Wilcox have designed, manufactured, and erected for use in the construction of the station. The crane which, as previously mentioned in these notes, is believed to be the largest of its type in the world, has now completed its commission tests and is in operation on the site, which it can traverse for a distance of more than 500-yd. from the assembly and fabrication area, to a point beyond the two main reactor buildings. The great height of the crane enables it to straddle and clear adequately the tops of the reactor buildings, which will be 180-ft. high when completed. The overall height of the crane is 240-ft., it has a span between centres of track rails of 250-ft., and is capable of lifting loads of up to 400 tons by means of two 200-ton lifting hooks each operated by its own hoisting gear and control cabin. The two hooks can be used as independent units, or their operation synchronised so that both hooks are controlled as a single unit when the heavier loads are being lifted. Approximately $1\frac{3}{4}$ miles of hoisting rope, $1\frac{3}{4}$-in. dia. is used by the two lifting beams. Each leg of the crane is mounted on two self-compensating bogies, running on single-line railway track, the bogies being electrically-operated, and provided with special means to synchronise the movement of the legs while the crane is moving. The maximum rate of travel is 50-ft./min. (just over one-half mile an hour), when carrying the heaviest loads envisaged, which will be about 385 tons. An important feature of the design and construction of the crane is, that it can be dismantled for transport by road, rail or sea for re-erection and use on other constructional undertakings. To achieve this, the 250-ft. long main girder or " bridge " and the 240-ft. high bipod legs are divided into a number of sections of a size convenient for normal transport, when they can then be bolted together on site to make up the complete crane. The leg sections and the bridge are of welded box-girder design giving great strength with economy of material, although the crane is so large that more than 1,600 tons of steel has been used in its construction. The erection of a crane of this magnitude required much ingenuity. For the purpose, each leg was erected section by section and temporarily guyed by steel ropes, in the vertical position. In the erection of the crane, nearly 500 bolts, 2-ft. 5-in. long

and 2-in. diameter, are used to connect together the main component sections and girders.

The complete bridge of the crane, weighing over 640 tons was lifted 240-ft. to its final position, using its own hoisting gears which were in position on the bridge. In effect, the crane " lifted itself by its own bootstraps." It is stated that this spectacular operation, calling for perfect control and co-operation between all concerned, was completed in just over an hour. When the bridge was hoisted to its full height, the legs were allowed to tilt inwards to their final positions, by progressive slackening of the outer guy ropes, until the ends of the bridge were resting on their bearings and the whole structure was finally secured.

Because of the arrangement of the lateral bracing between the main girders, it was not possible to take the hoisting ropes from the barrels down between these girders. The crabs were, therefore, designed with the barrels positioned at the outer edges of the crab so that the ropes from one barrel are on the outside of one main girder, and those from the other barrel on the outside of the other main girder. The main hoisting gear on each crab lifts 200-tons at a speed of 4.2-ft./min. The motor has an output of 150-b.h.p. and drives the two 10-ft. dia. main barrels through worm and spur gears. On each crab there is an auxiliary hoisting gear, capable of handling a load of 30-tons at a speed of 16-ft./min. The motor has an output of 45-b.h.p. and drives through worm and spur gears the auxiliary barrel, which is placed near the centre of the crab frame. The ropes from the auxiliary barrel are led over pulleys so that the hook operates on the outside of the girders, at one side. Each crab is mounted on four rail wheels, and the crab is traversed across the girders by a 30 b.h.p. motor driving two of the rail wheels through worm and spur gearing. The two " feet " on each crane leg are each supported on a compensating girder, which is in turn, supported on two bogies, each bogie having four rail wheels running on a single track, the wheels and bogies being fully compensated. One of the two travelling bogies at the foot of each leg is equipped with a motor which drives through worm and spur gearing all the four wheels on this bogie, the companion bogie in each case having four " trailing " rail-wheels. There are four " travelling " motors, each having an output of 80 b.h.p., giving a " travelling " speed of 50-ft./min. Directly coupled to each motor is a power Selsyn of 35 b.h.p. capacity, the purpose of these Selsyn units being to ensure the synchronisation of the four " travelling " motors under all loading conditions. The electrical supply to the crane is 415-V,





(Above). *Pre-assembly at the Renfrew works of Babcock & Wilcox Ltd., of one course of a 67 ft. dia. reactor pressure vessel.*

(Above, right). *Fabrication on site of No. 1 course and supporting skirt of a reactor pressure-vessel.*

(Right). *Site fabrication of the shell of one of the 90 ft. high by 21 ft. 6 in. dia. steam-raising units.*

(Left). General view of the erection by Babcock & Wilcox Ltd. of the 400-ton Goliath crane, during the lifting of the main bridge.

(Right). The Goliath crane completed and in service at Hinkley Point.

three-phase, 50 c/s. The main hoist and auxiliary hoist control gear and the cross-traversing control gear of each crab are of the reversing-contactor type operated by a master controller for each motion, with provision for slow-speed hoisting and lowering, and for plugging in both directions of traverse. An electrically-operated passenger lift is provided on one of the legs to give easy access to the top of the crane. Also, on the same leg there is a stairway leading from ground level to the top of the leg. Access ladders and platforms provide access where necessary, to all parts of the crane for lubrication and maintenance. When the tests with the 400-tons maximum working load had been completed satisfactorily, a test load of 500-tons was applied and the crane once more operated through all motions.

It should be emphasised that the crane is essentially an erecting tool which has been designed specifically for quick and economical dismantling and transport, and subsequent reassembly on other sites. It might, indeed, be expected to be dismantled and re-erected a number of times, remaining on site for lengthy periods of time on each occasion. Freeman Fox & Partners in their capacity of consulting engineers, were responsible for the overall design of the crane structure which is designed to withstand wind loads of up to 100 m.p.h. velocity. Many new and unusual features are incorporated in the design.

Station data

From time to time we have published various technical details, capacities, etc., concerning the station, but the following figures include information additional to that previously made available by the company. Flow and circulation figures refer to one reactor only.

Reactor	
Number of reactors	Two
Reactor heat rating	966-MW
Diameter of pressure vessel	67-ft.
Thickness of pressure vessel (excluding internal insulation)	3-in.
Coolant	CO_2
Nominal max. can temp.	430 deg. C.
Reactor inlet temperature	178.9 deg. C.
Reactor bulked outlet temp.	373.3 deg. C.
Reactor inlet pressure	185 lb./sq. in. g.
Reactor gas mass flow	10,300 lb./sec.
Total reactor pressure drop	4.45 lb./sq. in.
Circuit pressure drop	8.63 lb./sq. in.
Boilers and Turbines:	
Number of steam raising units	Twelve
H.P. steam pressure	640 lb./sq. in. g.
H.P. steam temperature	685 deg. F.
L.P. steam pressure	170 lb./sq. in. g.
L.P. steam temperature	660 deg. F.
Total steam flow	2.76×10^6 lb./hr.
Total H.P. steam flow	1.76×10^6 lb./hr.
Total L.P. steam flow	1.00×10^6 lb./hr.
Number of main turbines	Six
Output of each turbine	87-MW
Number of variable frequency turbines	Three
Load on variable frequency turbines/reactor	25.2-MW
Heat transferred to gas by circulators/reactor	22.9-MW
Maximum capability of each variable frequency turbine	33-MW
Heat transferred from gas in boiler/reactor	986.2-MW
Main Circulators:	
Number of circulators	Twelve
Type of circulator	Single-stage axial
Blower temperature rise	5.0 deg. C.
Output:	
Net electrical output	500-MW
Net efficiency	0.26

William Boby & Co. Ltd., Rickmansworth, have designed, and are building, what is believed to be the world's largest deaerator for the feed-heating system associated with the 550-MW Parsons turbo-alternator set at the C.E.G.B. Thorpe Marsh Power Station, near Doncaster. The turbo-alternator set will be nearly 300-ft. long, and the deaerator plant will occupy some 36,000 cu. ft., being about 80-ft. long, 15-ft. wide, and standing about 30-ft. high. Boby's are also supplying what are believed to be the two next largest deaerators built in this country for the feed heating systems of the two 275-MW English Electric sets being installed at the C.E.G.B. Blyth "B" power station, Northumberland.

Sulzer Brothers Limited

125th Anniversary

THIS year Sulzer Brothers Ltd. celebrate the 125th anniversary of their foundation. Started originally as a family iron founding business at Winterthur, Switzerland, in 1834, the firm became a limited liability company in 1914, and today, as an international organisation, their production range includes diesel engines, gas turbines, pumps, fans, steam boiler plants, high-pressure pipe lines, steam turbines, compressors and blowers, refrigerating machinery, heating and air conditioning installations, weaving machines and foundry products. The company are also well known as manufacturers of diesel-electric locomotives. These are four-stroke turbo-charged models with ratings from 725 to 2,300 h.p. at 950 to 750 r.p.m. Locomotives with these higher ratings are now being supplied to British Railways.

The Sulzer steam engine was the first enterprise to carry the reputation of the firm outside Switzerland. The horizontal poppet-valve steam engine which they exhibited at the 1867 World's Fair in Paris attracted considerable attention, but later they became even more widely known, especially in shipping circles, for their share in the development of the diesel engine. The first reversible two-stroke marine diesel engine was exhibited by them at the World's Fair of 1906, in Milan. The total power of Sulzer diesel engines sold to date exceeds 14-million h.p., and the production of the parent works at Winterthur now amounts to 150,000-180,000 h.p. annually. Most of these are large two-stroke marine units, while in addition there are two-stroke trunk-piston engines of medium rating for marine propulsion and power generation. Four-stroke engines, with and without supercharging, are built, and new welded two-stroke marine engines for operation on heavy fuel oils and for exhaust-gas turbo-charging have also been developed. With their latest engines (type-RSAD76), which are scavenged exclusively by their exhaust-gas turbo-charges, Sulzer Brothers have consolidated their position in the first rank of marine engine designers. The greatest possible simplicity (the Sulzer cross-scavenging system has been retained from the first), small space requirements, good accessibility of all parts and low fuel consumption are among the many advantages of these two-stroke engines, which are built with from five to twelve cylinders. As the normal output per cylinder is 1,300 h.p., the largest unit attains 15,600 h.p. at nominal load and over 18,000 h.p. at maximum load.

Centrifugal pumps and fans were first manufactured by the company in 1860 and today they are built in all types and sizes, from the smallest unit for domestic water supplies up to large sets for city waterworks and storage plants for hydro-electric power stations.

Another important date in the Sulzer history was 1841 when they constructed their first steam boiler. Today the company are among the leading boiler manufacturers and act as general contractors for the planning and construction of thermal equipment for public and industrial power stations and district heating plants. For medium-pressure steam plants they build water-tube boilers with capacities from 1,000 to 350,000 lb./hr. and for pressures up to 900 lb./sq. in., while the well-known Sulzer Monotube steam generator has been developed for high and ultra-high pressures and temperatures. Today boiler plants operating on this latter system are being erected for supercritical pressures up to 5,600 lb./sq. in. and outputs up to 325-MW.

Among other products, Sulzer reciprocating compressors for chemical and industrial duties attain pressures up to 17,000 lb./sq. in. The largest ammonia condenser has a refrigerating capacity of 40-million B.Th.U./hr. Sulzer refrigerating machinery is also suitable for the production of very low temperatures, as employed in the chemical industry and in modern quick-freezing plants for the long-term storage of perishable foodstuffs such as meat, fruit and vegetables. Two- and three-stage compression and refrigerating temperatures as low as — 75 deg. F. are no longer exceptional in this field. The development of the Sulzer gas turbine began in 1939, and while the first plants operated on a semi-closed cycle designed for high-efficiency and large unit outputs, today, single-shaft turbine sets up to 13,000-kW predominate. Gas turbines operating on furnace blast have

General view from the air of the Oberwinterthur works of Sulzer Brothers Ltd.

been particularly successful; they generate electricity while at the same time driving blast-furnace and steelworks blowers. Gas turbines can also be employed to advantage wherever cheap fuels are available for continuous operation or where running periods are short, e.g., in peak-load power stations or emergency generating plants. The turbo-machine department, furthermore, manufactures axial and radial compressors for capacities up to 200,000 cu. ft./min. and practically all pressures required in industry, as well as exhaust-gas turbo-charges for two-stroke and four-stroke diesel engines. The construction of high-pressure pipe lines for hydro-electric power stations has expanded with the growing power demand, and Sulzer Brothers have played a leading part in the development of welded pipe lines, introducing new designing and manufacturing methods.

The production range of the heating and ventilating department is not restricted to steam and hot-water central heating plants—but also includes industrial thermal plants using high-temperature water or steam as a heat-carrying medium, hot-water supplies and drying plants, air conditioning and vapour dispersal equipment, electric heating and dry coke cooling plants and waste-heat recovery plants for paper machines and other uses. In recent years panel warming has been widely applied, while special equipment for the textile industry, such as suction clearer installations and spool dryers, have been developed.

Having originated in a foundry, the Sulzer company has always given special attention to this department. The foundries produce grey cast-iron, cast-steel, non-ferrous and precision castings, and more recently also modular cast-iron for highly stressed components, particularly crankshafts. These castings are not only provided to meet the firm's own requirements, but are also supplied to other Swiss and foreign engineering works. The annual production at Winterthur is today 20,000-tons, the largest single castings weighing as much as 50-tons.

New foundry

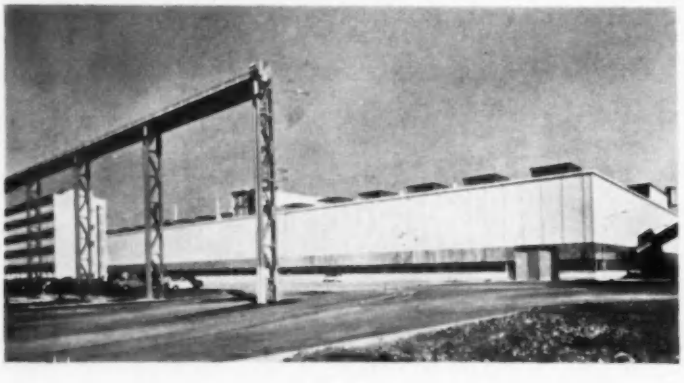
As working conditions in the foundries at Winterthur have become more and more congested, the company decided some years ago to erect a new iron and steel foundry at Oberwinterthur where, since 1907, they have maintained a second manufacturing centre. Here the new foundry building covers an area of nearly 350,000 sq. ft., and the plant installed is capable of producing castings weighing up to 120-tons, and already has an annual production of approximately 24,000-tons of steel and iron castings.

Of the various alternatives studied, the building eventually chosen comprised six bays running north to south, and to the north of these three transverse bays running east to west; these latter bays accommodate the core shop and two pattern shops. Steel castings are made in two of the six remaining bays, these being served by three arc furnaces of 3, 6 and 14-tons capacity, and two medium-frequency induction furnaces of ½- and 1-ton capacity. The other four bays producing iron castings are supplied with metal from two hot-blast cupolas. Both these units have hearth diameters of 43½-in., are over 76-ft. in height, and each has a melting output of 12-tons/hr. For reasons of economy it was decided to supplement the cupola installation with a battery of medium-frequency induction furnaces. This installation comprises four crucible furnaces with capacities from 2-10-tons.

For future extension it will be possible to erect one further bay each on the east and west sides, and to lengthen the building considerably to the north. The transverse bays are constructed so that the crane-tracks from the longitudinal bays can be carried through to the north, if necessary, without any substantial alterations.

A preparation plant at one end of the building supplies sand to all parts by a conveyor system, and there is also a central core-making section. All production is highly mechanised—a good example of this aspect of the foundry being the green-sand moulding shop for grey cast-iron. Here moulds are produced by a fixed-cycle system on a turntable which rotates through 90° at each movement. The moulding boxes are produced in four stages as follows: (1) Assembly of pattern and moulding box. (2) Filling with moulding sand by a filling unit. (3) Ramming-up of the mould with a sandslinger. (4) Transferring of the box on to a roller-conveyor leading to a turn-over machine. The boxes pass by way of the turning and lifting machine to the casting lines where they await pouring. After coming from a 20-ton shake-out, the used boxes travel back along a special roller-conveyor to the vicinity of the turntable.

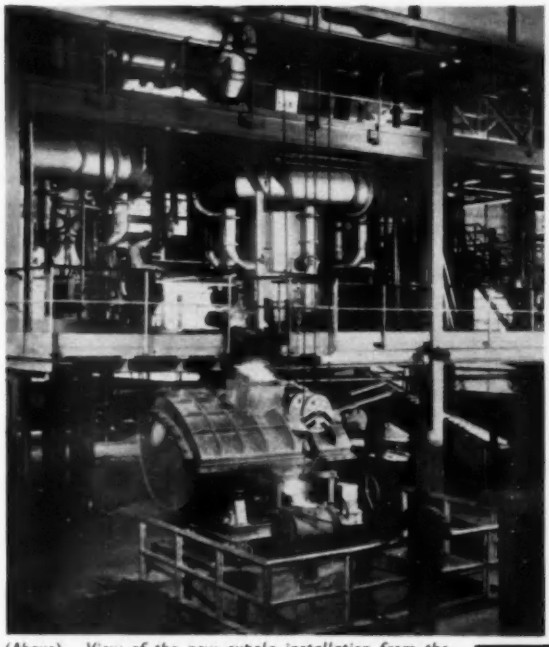
An interesting development in this process is the use of a sandslinger, by which the sand is hurled into the mould centrifugally by means of a rotating wheel. The motor-driven wheel of the latest models delivers approximately 0.35 cu. ft./sec. of sand at a speed of around 160-ft./sec. The sandslinger, although used in America for the past 30 years, has only recently been introduced into Europe. The five units at Oberwinterthur handle some 3½-million cu. ft. of sand annually.



The new foundry from the south-west. On the left can be seen part of the new five-storey office building.

Services

In metallurgical furnaces, mould-drying ovens, etc., large quantities of hot water and air are produced and must be disposed of. The waste heat recovery plant of the new foundry operates in three stages at 158, 104 and 77 deg. F. The pre-heaters of the ventilation system and the hot-water installation for the large washrooms are connected to the first stage and the hot-



(Above). View of the new cupola installation from the front. This comprises two hot-blast units, each with a melting output of 12-tons/hr.

(Right). View of turntable, sandfiller, sandslinger, turn-over machine and sandcutter in the green-sand moulding shop for grey iron.

water pre-heaters to the second stage, while the water is returned from the third stage to the various cooling circuits.

Water supplies are taken from the mains system covering the entire works, which is fed partly from the Winterthur town supply and partly from the company's own ground water well. Distribution to the foundry is effected through underground pipe ducts, and inside the foundry through overhead pipelines. The underground pipe ducts mentioned above are used elsewhere in the Sulzer works for all types of piping and cables, but as stated, are not continued inside the foundry area, in order not to restrict the space available for the underground foundry installations.

In addition to the water pipes there is an extensive supply system for compressed air, which is obtained from the central compressed-air plant of the Oberwinterthur works ; for oil, which is required in large quantities for the generation of heat at various points ; for gas, supplied by the municipal gasworks ; and for oxygen, delivered through a pipeline from an oxygen plant at Grüze, belonging to the Sauerstoff- und Wasserstoff-Werke AG. of Lucerne.

The foundry receives electricity mainly through a number of 10,000-V cables from a newly erected transformer and distribution station. The high-voltage cables run along lines of columns in the various bays and lead to a number of stations at the main centres of consumption which are equipped with unit transformers of 1,000-kVA, 10,000/380/200-V. Low-voltage cables lead from these block stations in small floor channels to the various distribution boxes along the row of columns, and from there to points of consumption.

Altogether 31 cranes are installed with lifting capacities ranging between 5 and 80-tons, and among these, in addition to the overhead travelling cranes, are numerous smaller cranes of special types including semi-portal cranes serving part of a bay, with capacities up to 10-tons ; swivelling bracket cranes serving individual working areas; and compressed-air hoists for special duties in working areas handling small components up to 1-ton.

A special laboratory is responsible for sand control and research, while the new foundry can call upon the services of the metallurgical laboratory attached to it and the Sulzer central laboratories. Here, not only are purely practical problems investigated, but research work is carried out in the fields of foundry and materials technology in order to improve further the manufacturing processes and the quality of the castings produced.

Also recently completed at Oberwinterthur is a new heavy machining shop, comprising two bays. One of these is equipped for what might be termed "flat" work involving the use of planing, milling, radial drilling and horizontal boring machines, while the second bay is concerned with the manufacture of crankshafts, cylinder liners and pistons.

W. H. Allen Sons & Co. Ltd. have received orders for eight Allen-Stoeckicht epicyclic gear units for motor-driven boiler-feed pumps, for installation in the new Blyth "B" and Richborough power stations of the Central Electricity Generating Board. For the Blyth "B" station, four 4,000-h.p. speed-increasing gear units have been ordered by Hawthorn Davy & Co. Ltd., each gear designed to increase the motor speed from 1,480 r.p.m. up to the pump speed of 4,500 r.p.m. The four gear units for the Richborough station, ordered by the Harland Engineering Co. Ltd., are also speed-increasing gears, designed to transmit 2,600-h.p. through a speed increase of 1,490/5,500 r.p.m. Epicyclic gears are also to be used in the Richborough power station on the main 120-MW Richardsons Westgarth turbo-alternators for the speed-reduction drive to the alternator exciter. All the foregoing gears are being built at the Atlas Works, Pershore, Worcestershire, of W. H. Allen Sons & Co. Ltd.

Trawsfynydd Nuclear Power Station

A LETTER of intent was issued recently by the Central Electricity Generating Board to Atomic Power Constructions Ltd.* to enter into a contract for the design, construction, and commissioning of a 500-MW nuclear power station at Trawsfynydd, North Wales. The proposals made by Atomic Power Constructions Limited, include a development scheme for Portmadoc Harbour to enable much of the heavy plant and equipment to be sent to the site by sea.

The Trawsfynydd site is about 600-ft. above sea level on the northern shore of the artificial Trawsfynydd lake which was created some 30 years ago to serve as a storage reservoir for the Maentwrog hydro-electric power station. This lake is large enough to provide the 35-million gal./hr. of cooling water required for the nuclear station. The land, which is owned by the C.E.G.B., is rocky and broken and of no agricultural value. The reactors will be built directly on rock foundations. The station will be connected by overhead line to the 275-kV supergrid transmission system at the Ffestiniog pump storage station now under construction five miles to the north.

The design of the power station provides for two natural-uranium graphite-moderated gas-cooled reactors operating in conjunction with steam-raising units and turbo-alternators to give a net station output of 500-MW.

The principal structures in the proposals submitted by Atomic Power Constructions Limited will be two reactor buildings, a turbine house and an outdoor switching station.

The graphite moderator structure will be about 48-ft. across flats and 27-ft. 6-in. high, and will contain 3,720 vertical fuel element channels on a square lattice pitch of 7¾-in. The moderator will be built up of machine graphite blocks held together by circumferential restraint members. The vertical fuel element channels will contain fuel elements of natural uranium sheathed in a magnesium alloy can, with an extended surface to give improved heat transfer, and four longitudinal alloy splitters to centralise the element in the channel. The diameter of the fuel element channel is constant throughout the core. The channels, outside the flattened zone of the reactor, are gagged to ensure that heat is removed at the highest outlet gas temperature. A fabricated steel grid carried on pillars and struts from the inner skirt of the pressure-vessel will support the graphite structure. Differential expansion between the moderator and its support will be accommodated by a series of ball thrust races.

The graphite structure will be contained in a spherical steel pressure-vessel 61-ft. internal diameter, fabricated from plate 3½-in. thick. A circumferential gas-seal will be fitted between the pressure vessel and the graphite structure.

Heat will be removed from the reactor by means of carbon-dioxide gas at a nominal pressure of 240 lb./sq. in. Six boilers or steam-raising units will be connected to each reactor pressure vessel by ducts 5-ft. 6-in. dia.; these being provided with expansion bellows and isolating valves.

Boilers

The six boilers for each reactor will be placed in line in two groups of three, on opposite sides of the pressure vessel. The boiler shells are to be 18-ft. internal diameter and 116-ft. high and fabricated from 2½-in. thick steel boiler plate. A dual-pressure steam cycle has been adopted, the boilers generating 65 per cent. of the steam at the high-pressure. Each boiler shell will contain six sets of tube banks, namely, mixed economiser, l.p. evaporator, h.p. economiser, h.p. evaporator, l.p. superheater and h.p. superheater. All tubes throughout the boiler will have external resistance-welded fins, to improve the heat transfer between the gas and the steam.

Installed vertically below each boiler will be a gas-circulator or single-stage axial-flow fan, designed to return the CO_2 to the reactor. The circulator drive will comprise a constant-speed direct-coupled 6,000 h.p. induction motor running at 2,950 r.p.m. During operation, the gas flow will be regulated by linked throttle valves in the main gas-ducts, and by-pass valves in recirculation ducts.

The reactor building will house the reactor and the boilers, and will occupy an area of approximately 300-ft. by 180-ft. at ground level. The height will be 179-ft. Each boiler, with its associated gas ducts, is to be individually shielded along its entire length by shield walls which connect with the biological shield of the reactor itself. At boiler plinth level the building will be extended to form a common circulator house containing the electric motors for the gas-circulators.

On-load fuel-handling is to be provided by charge machines, each of which will be a composite unit capable of carrying out all operations connected with the fuel-handling system on the charge face. The machines will be approximately 64-ft. high and weigh approximately 380-tons, each. Remote and local control will be provided for charge machine operations, but normal operation will be from a remote control room near the charge face.

Control of the station during normal operation will be carried out from a central control room, sited between the two reactor buildings. There will be two automatic control loops external to the reactor; one is primarily intended to eliminate instabilities in the reactor neutron flux, the other to be used for adjusting the reactor output to meet the load demand. Provision is to be made for full automatic control of the station, if required at some future date.

**Atomic Power Constructions Limited is a group formed at the end of 1956, and consists of Crompton Parkinson Limited, Fairey Aviation Limited, International Combustion (Holdings) Limited, and Richardsons Westgarth & Co. Ltd., in association with Nuclear Civil Constructors, a partnership of Trollope & Colls Ltd., and Holland & Hannen and Cubitts Ltd., to provide the civil engineering organisation of the group.*

The turbo-alternators will be arranged transversely in a turbine house approximately 450-ft. long and 220-ft. wide. Each generator will have a maximum continuous rating of 145-MW and will be a four-cylinder machine designed for a dual-pressure steam cycle, the steam being discharged from each turbine through six exhausts into twin condensers. The alternators will have water-cooled stator windings. The steam conditions at the turbine stop valve are to be as follows:—h.p. steam 927 lb./sq. in. and 715 deg. F.; l.p. steam 290 lb./sq. in. and 685 deg. F.; steam flow ratio 65 per cent. h.p., 35 per cent. l.p.

The generator output will be stepped up to 275-kV by 157-MVA transformers connected by cables to the C.E.G.B. switching compound about 300-ft. away. Auxiliary transformers will be provided in addition for a supply at 11-kV and 415-V for the power station requirements.

The circulating-water pump house will contain six pumps capable of circulating 500,000 gal./min. of water drawn from Trawsfynydd lake and returned to it for natural cooling.

The first stage of the contract will involve nearly half-a-million cubic yards of excavation, a large amount of this being rock which will involve blasting. A Goliath crane, having a span of 250-ft. and a lifting height of 200-ft., will be used to lift loads of up to 400-tons in weight.

Work on the site commenced on July 1st, 1959, and it is anticipated that the completed station will be fully operational in 1964.

The main work will be allocated as follows:—*Crompton Parkinson Limited* will be responsible for the 275-kV generator transformer; station, unit and auxiliary transformers; 11-kV, 750-MVA switchgear; 415-V switchgear; switchgear control panels; auxiliary motors and alternators; cables and lighting equipment. *Fairey Aviation Limited* will provide reactor equipment including charge machines; control rod mechanisms; graphite machining and laying equipment; and irradiated fuel disposal equipment. *International Combustion (Holdings) Limited* will be responsible for the 12 boilers, each of 150-MW heat rating; the main and recirculation CO_2 gas ducting; and the biological shield cooling system. *Richardsons Westgarth & Co. Ltd.* will supply the 145-MW turbo alternator sets; condensers and feed-heating plant; dump condensing plant; and CO_2 gas-circulators and associated plant. *Nuclear Civil Constructors* will be responsible for civil engineering work. *Babcock & Wilcox Limited*, as sub-contractors, will manufacture the two spherical reactor pressure-vessels, each 61-ft. diam., and will also supply the 400-ton Goliath crane.

Stewarts and Lloyds Limited have received an order for the supply of approximately 270-miles of 16-in. dia. steel piping for use in the construction of an oil pipeline in Assam, north-east India. The order has been placed by The Burmah Oil Co. Ltd., London, on behalf of Oil India Private Limited and in agreement with the Government of India. The pipeline will run from the oilfields at Nahorkatiya, in Upper Assam, where substantial reserves of oil were discovered in 1953 by drillers of the Assam Oil Co. Ltd. (a wholly owned Burmah Oil subsidiary) to an oil refinery to be erected near Gauhati, in Assam. This refinery, the first of two which are to be built by the Government of India, is expected to be in operation in 1961. The second refinery will be erected at Barauni, in the State of Bihar, and the oil pipeline will be extended to that plant in a later stage of the operation, making the total length of the line 720 miles. The new refineries will process crude oil produced in Upper Assam and transported to them by Oil India Private Limited, a newly-formed company in which the Government of India and The Burmah Oil Co. Ltd. are partners. India recently accepted credits of £3 million from the British Government for the purchase of pipe and ancillary plant for the pipeline in the U.K. Burmah Oil Company has offered to lend a total of £20 million to Oil India towards the sterling exchange cost of the project. The oilfield at Nahorkatiya, and the neighbouring field of Moran, are capable of a production of about 2½ million tons of crude oil per annum. Both fields are now awaiting completion of the pipeline and refineries. At the present time, the only producing oilfield in India is the small, but locally important, Digboi field, in Upper Assam, which was discovered in 1889. The pipe line to be supplied by Stewarts and Lloyds Limited, will cost £2 million and will comprise 32,000 tons of 16-in. pipe made to A.P.I. standard 5L X46. Delivery will be made to Calcutta at the rate of four to five thousand tons a month between September, 1959, and March, 1960. The piping will be manufactured at the Clydesdale Works of Stewarts and Lloyds.

G. & J. Weir Limited, Glasgow, and **Chicago Bridge & Iron Company,** Chicago, Ill., announce that they are setting up a jointly-owned subsidiary company in the United States to be known as Weir-Chicago Bridge Inc. The new company will have as its objective the design, fabrication and erection of saline water conversion plants. The company will be combining the knowledge and experience of G. & J. Weir Limited, as manufacturers of large sea-water evaporation and distillation plants, with the fabrication and construction facilities of the Chicago Bridge Company. G. & J. Weir Limited are the leading manufacturers of large sea-water evaporation plants, having supplied plants with a total capacity of 12 million gal./day, which is equivalent to more than two-thirds of the total installed world capacity. The firm's most recent "Multi-flash" design has resulted in important economies in the cost of fresh water produced. Currently under construction are a 40-stage "Multi-flash" plant for the Island of Guernsey and two 1,200,000 gal. plants for the state of Kuwait. These latter are the largest individual units to be built. Chicago Bridge & Iron Company are the leading builders of large evaporators for the pulp and chemical industries of the United States; they have extensive fabrication and erection facilities throughout the United States and over the rest of the world, as well as a well-distributed organisation of sales offices. This strong partnership will make available to American water authorities, all the advantages of Weir experience and technique together with the unrivalled production and erection resources of Chicago Bridge.

The Central Electricity Generating Board have placed an order with **Worthington-Simpson Limited,** Newark, Notts., for the supply of the complete condensing and feed-heating plant for one 120-MW turbo-alternator of English Electric Company's manufacture, at Bankside "B" power station, London. The plant will comprise one 70,000 sq. ft. surface condenser, hydraulic rotary air-pumps, extraction pumps and feedwater heaters. The condenser is designed to condense 570,000 lb./hr. of steam at an absolute pressure of 1.1-in. Hg. when supplied with 60,000 g.p.m. of circulating water at 55 deg. F. Air removal equipment will be of the latest Worthington-Simpson hydraulic rotary air-pump type, comprising three 50 per cent. capacity elements mounted on one sealing water tank complete with operating water pumps. These units replace the conventional steam-jet operated air-ejectors. Condensate extraction will be by means of two 100 per cent. capacity extraction pumps, each capable of handling 1,150 g.p.m. at a total head (including vacuum) of 270-ft. The feed-heating plant is designed to heat the feedwater to a temperature of 435 deg. F. at 120-MW load. This will be accomplished by using bled-steam from the turbine from six bled-steam tapping points. There will be two l.p. heaters, one deaerator, to reduce the oxygen content of the feedwater to 0.007 p.p.m., and three h.p. heaters. The contract includes the supply of all inter-connecting pipework, valves and associated equipment and erection at site.

180-ton Stator Lifting Equipment at Willington 'A' Power Station

By K. H. ROSE, A.M.I.Mech.E.

WHEN designing a power station, a considerable amount of thought has to be given to the problem of the lifting of heavy plant into position both from the point of view of initial installation, and for maintenance purposes during its operational life. This does not usually present any very special problems where an overhead travelling crane is required, and the lifting capacity of such a crane is determined by the weight of the heaviest item of plant or equipment to be handled.

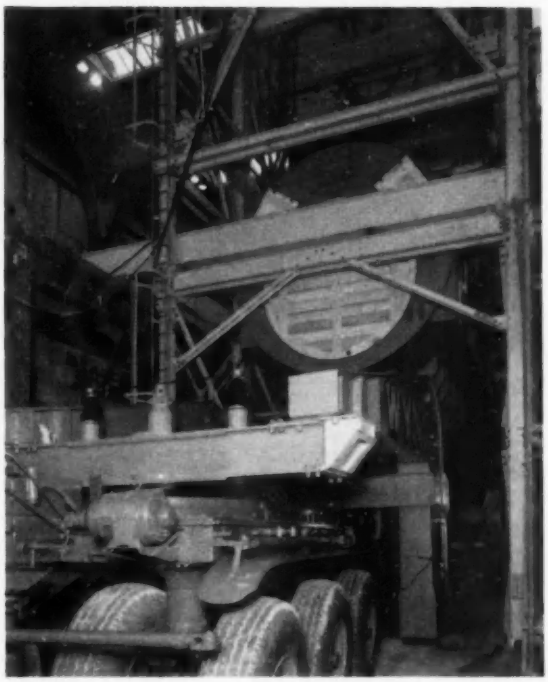
At Willington "A" Power Station of the Central Electricity Generating Board, a new method of handling and lifting the alternator stators into position was devised, which enabled turbine house cranes of reduced capacity to be provided. The equipment in question is described in the following notes.

Willington "A" Power Station has two individual turbine houses, each containing two 100-MW turbo-alternators of English Electric Company's design and manufacture, together with the associated feed-heating and condensing plant, boiler feed pumps, etc. The two turbo-alternators in each turbine house are arranged longitudinally, with the alternators of each machine placed towards their respective ends of the building. There is a loading bay at ground level, adjacent to each turbine block, and this extends from the ends of the building up to the inboard ends of the alternators. The central portion between the loading bays containing the turbines, condensing plant, feed-heating plant and boiler feed pumps is 10-ft. below ground level. The heaviest items of equipment to be handled were the alternator stators, which each weigh 160 tons, the next heaviest being the alternator rotors, each weighing 42 tons.

Normally, an electric overhead travelling crane of 165 tons capacity would have been provided in each turbine house for lifting the stators into position on to the turbine blocks, but it was evident that if some other means of handling the stators could be devised, a large reduction in cost might be effected—not only in the actual cost of the cranes, which would thus be provided simply for the next heaviest lift of 42 tons, but in the cost of foundations and superstructure also. In addition, there might also be an appreciable reduction in the construction time required for such civil engineering work. Thus, the idea of a demountable stator lifting equipment was considered, and preliminary designs and estimates indicated that the proposal was both sound and feasible.

At that time, the construction of the second station (Willington "B") was envisaged, and it was decided to design the stator-lifting equipment to handle the stators of the 200-MW turbo-alternators which this new "B" station would contain; their lifting weight would be 180 tons. For dealing with the next heaviest lift (42 tons) in each of the Willington "A" turbine houses, it was decided to install conventional 50-ton capacity electric overhead travelling cranes.

The stator-lifting equipment which has been provided comprises a tower structure which is erected on the loading bay alongside the turbine block, the centre-line of the structure being on the centre-line of the alternator. One end of the structure overhangs the central portion of the turbine-house floor (which, as mentioned, is 10-ft. below ground level); the two columns at this end being carried down to this level. The tower structure is arranged in two halves, the division being at the 20-ft. level, which corresponds to the top of the turbine block, and these two halves are securely bolted together when in position in the loading bay. The reason for this division will be seen later when discussing the sequence of lifting operations. Eight soleplates are



Stator for Willington "A" No. 1 set being lifted from its transporter.

provided in the turbine-house floor, and the lower half of the structure is securely bolted to these. Eight soleplates are also provided on the turbine block for the attachment of the top-half of the structure before moving the stator into its final position on the block. On top of the upper half of the structure are mounted four 50-ton capacity electric hoisting units complete with snatch blocks, the centre lines of which correspond to the lifting points on the stator. The control of these hoisting units is arranged so that they can be operated either independently for levelling the load, or collectively for raising or lowering the load by the use of a master controller. Across the top of the turbine block and the lower portion of the structure are laid two traversing beams, each of them split into two to allow for ease of handling; and on top of these are four bogies which carry two cradle beams. These in turn carry the stator itself—the stator being bolted to these beams through the fixing holes in the stator-frame feet.

At one end of the traversing beams, and on the opposite side of the turbine block to the loading bay, are two five-ton capacity traversing winches, the ropes from which are connected to the foremost cradle bogies. A chain linkage connects pairs of bogies on the same traversing beam, and the ropes return to the traversing winches via pulleys attached to the lower-half of the tower structure. This enables the stator to be traversed in either direction for installation or removal, or squaring the load, as the case may be. A small control panel is mounted in a convenient position on the turbine operating floor at the 20-ft. level. This panel carries the necessary control equipment for operation of the hoisting and traversing winches.

A temporary platform had to be provided, built up from the turbine-house basement-level, which formed an extension to the loading bay at ground-level. This was necessary in view of the length of the stator transporter, the front part of which overhung the lower level with the stator in position under the lifting equipment.

Before being put into use, the lifting equipment was tested at 25 per cent. overload (i.e., 225 tons) through all phases of its operation, assimilating exactly all the operations of installing a stator.

Sequence of operations

The sequence of operations for the installation of a stator is as follows:—

(1) The tower structure, complete with hoisting units, is first erected adjacent to the turbine block, the centre-line of the structure being on the same centre-line as the stator in its final position. The traversing beams are placed in convenient positions on the turbine block.

(2) The stator is brought into position under the lifting equipment on its transporter, lifting ropes are attached to the snatch blocks, and the stator lifted high enough to clear the transporter, which is then removed from under the lifting equipment.

(3) The cradle beams, which are already mounted on their bogies, are lifted on to the transporter by the turbine house crane, and the transporter returned to its position under the lifting equipment.

(4) The stator is lowered on to the cradle beams, securely bolted to them, and then lifted to its maximum height; the transporter then being removed.

(5) By using the turbine-house crane the two traversing beams are manoeuvred into position across the top of the turbine block and the lower-half of the tower structure, and securely bolted down.

(6) The stator, mounted on its cradle-beams and bogies, is then lowered on to the traversing beams, and the wire ropes from the traversing winches are attached to the bogies.

(7) The upper-half of the lifting structure is disconnected from the lower-half, and wire rope slings fitted at lifting points on the upper-half are attached to the turbine-house crane hook. This upper-half of the structure is then lifted approximately 1-ft. clear of the lower-half of the structure by the turbine-house crane.

(8) The stator is moved on to the turbine block, by means of the traversing winches; at the same time the upper-half of the lifting structure is traversed by the turbine house crane. When the stator is over its final position, the lifting structure is lowered on to the soleplates provided on the turbine block and bolted down.

(9) The stator is unbolted from the cradle beams and lifted clear, and the cradle beams, bogies and traversing beams removed by the turbine-house crane.

(10) The stator is then lowered to its final position on the turbine block.

The equipment has been successfully used for the installation of the stators on all four turbo-alternators installed in the "A" station, major dismantling being necessary when transferring the equipment from one machine to the other, and almost complete dismantling when transferring it from No. 2 turbo-alternator to No. 3 turbo-alternator as the latter is, of course, located in a separate turbine house.

Permission was obtained from the Central Electricity Generating Board's insurers to dispense with overload testing of the equipment prior to lifting any subsequent stators after the first one, provided that the equipment had been tested within the previous four years, and that it is inspected before each erection, and at six-monthly intervals whilst erected.

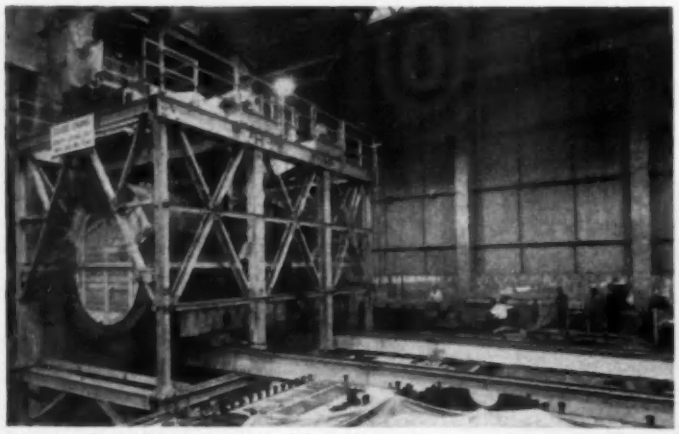
No difficulties have been encountered with the turbine manufacturer regarding the lifting and installation of stators in this manner; the complete operation being looked upon by the manufacturer in precisely the same way as if the stators were to be lifted and placed in position by a full capacity overhead electric travelling crane. The turbine manufacturer is, however, responsible for issuing the necessary instructions to the operator of the lifting equipment for all operations involved in the installation of a stator.

The Central Electricity Generating Board has not been involved in any additional charges, either for erection of the equipment or for insurance, as a result of installing stators by this new method.

When the specification for the equipment was prepared, one of the stipulations in its design was that the total weight of the upper-half of the structure including hoist units and snatch blocks should not exceed 50 tons; this being the safe lifting capacity of the turbine house travelling crane. Unfortunately this could not be strictly adhered to, and in the final assessment the total weight amounted

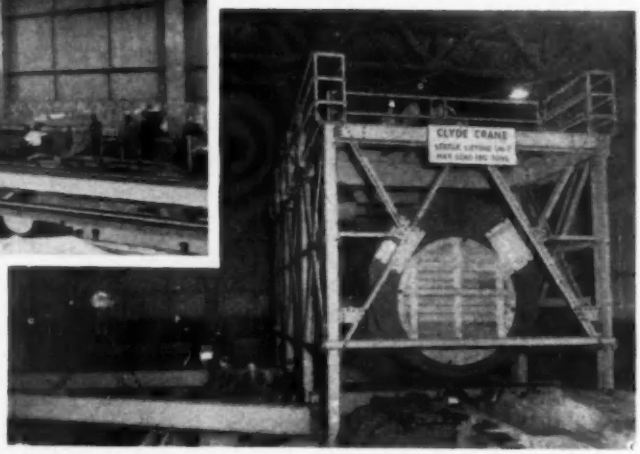
to 53 tons. In order to overcome this difficulty, saddles were provided which rested on the stator, and the four snatch-blocks were lowered on to these and the lifting ropes allowed to slacken before the turbine house crane began to lift the upper-half of the structure. This reduced the total weight to be lifted by the travelling crane to approximately 49 tons, which was within its safe lifting capacity.

During the installation of No. 1 stator a detailed time-table was compiled of the various operations from the arrival of the stator on site. From this timetable it appears that the total working time from the lifting of the stator from the transporter and fitting it to the lifting cradle, until it was lowered into its final position on the foundation blocks was about 19¼ hours. From the experience gained, minor modifications were made to the equipment which considerably reduced the time taken to install subsequent stators. Actually, the complete installation of the stator for No. 4 turbo-alternator was achieved in one day.

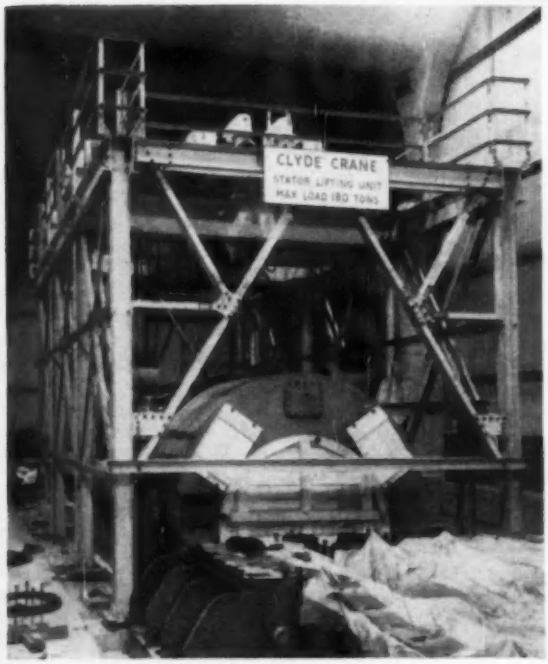


(Above). The 180-ton stator being lifted and placed on the traversing rail beams.

(Below). One pair of traversing bogies removed, and first beam being drawn out by overhead crane.



(Below). Operation complete with stator lowered to its final position.



Comparison of schemes for handling stators

To obtain as reliable an assessment as possible of the relative costs of the stator lifting equipment and a conventional full-capacity turbine-house crane, a detailed design was made of a building with a 165-ton crane, based on the same general layout as the existing building; and this design was then estimated on the rates of the existing civil contracts. For comparison, the two schemes are set out in tabular form below.

Design Requirements	*165-ton turbine house crane*	*50-ton turbine house crane, plus lifting equipment*
	ft. in.	ft. in.
Crane span	70 0	70 0
Main column centres (transverse)	72 6	72 6
Roof column centres (transverse)	75 6	74 9
Main column centres (longitudinal)	31 0	30 3
Roof column centres (longitudinal)	31 0	30 3
Height of crane rail	51 6	51 6
Headroom over crane rail	18 6	12 2
Depth of roof barrel	7 9	7 10½
	ft. in. ft. on.	ft. in. ft. in.
Section of main columns	5 6 × 3 0	4 6 × 2 3
Section of roof columns	3 0 × 2 6	2 3 × 1 6
Section of roof ribs	2 6 × 2 0	2 3 × 1 6
Section of crane gantry	4 6 × 3 0	3 6 × 2 0
Main col. foundation load	260 tons	150 tons

Economic Comparison
Willington "A" Power Station
(Four 100-MW Turbo-Alternators)

	Using a 165-ton crane in each turbine house	*Using a 50-ton crane in each turbine house plus lifting equipment*
	£	£
Cost of foundations for two turbine houses	296,800	252,600
Cost of superstructure for two houses	245,000	212,500
Cost of two turbine house cranes	65,000	28,100
Cost of stator lifting equipment (erected and tested)	—	28,500
Cost of dismantling and re-erection for No. 2 set	—	1,700
Cost of dismantling and re-erection for No. 3 set	—	2,200
Cost of dismantling and re-erection for No. 4 set	—	1,700
Cost of dismantling from No. 4 set, cleaning, oiling and removing to store	—	1,500
	606,800	528,800

Saving due to stator lifting equipment = £78,000, which is equivalent to a saving of 3.9s. per kW installed.

The above figures show that economically the stator lifting equipment is justified and that for subsequent stations containing two 200 MW sets a saving of the order of 5s. per kW can be expected.

Willington "B" Power Station
(Two 200-MW Turbo-Alternators)

	180-ton turbine house crane	*55-ton turbine house crane plus lifting equipment*
	£	£
Estimated cost of turbine house foundations and superstructure	400,000	315,000
Cost of turbine house crane	43,000	22,500
Cost of removing stator lifting equipment from store, erecting and dismantling twice and returning to store	—	5,000
Cost of testing stator lifting equipment	—	2,500
	443,000	345,000

Saving due to stator lifting equipment = £98,000, which is equivalent to a saving of 4.9s. per kW installed.

In conclusion the author acknowledges his indebtedness to the Central Electricity Generating Board for granting permission for publication of this article, and to Ewbank & Partners Limited, the engineering consultants, who designed the station and supervised its construction and commissioning, for their co-operation and assistance in connection with the preparation of much of the detailed information.

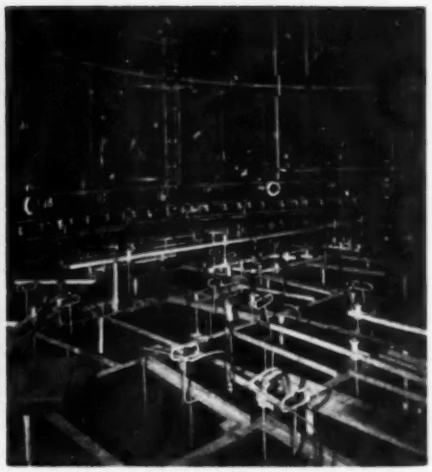
Pressure-Testing Berkeley Reactor Vessel

IT is anticipated that the No. 1 reactor vessel, together with its associated units, comprising half the Berkeley nuclear power station, will be completed towards the end of 1960. The eight heat-exchangers are, for example, all erected and are now being tubed. A further important step towards this completion date was made recently with the pressure-testing of the reactor pressure vessel. John Thompson Limited, who are members of the A.E.I.-John Thompson Nuclear Energy Company, the main contracting company responsible for the building of the Berkeley station, manufactured and erected the pressure-vessel and carried out the pneumatic test. Stress relieving of the vessel was also carried out by the company some weeks earlier.

Prior to pressure-testing, it was necessary to X-ray the 2,500-ft. of welding involved in the construction of the vessel, which is 80-ft. high, has a diameter of 50-ft., and was fabricated from mild steel of 3 to 4-in. thickness. In order that it should be entirely leakproof throughout the test, all inlets were blanked-off and, to ensure that the vessel was constantly situated in still air, all apertures in the 11-ft. thick concrete biological shielding were closed. These arrangements also maintained the skin temperature of the vessel at a constant temperature of 75 deg. F. during test. The actual pressure-testing of the vessel, the design and working pressures of which are respectively 137 lb./sq. in. and 125 lb./sq. in., was at 211 lb./sq. in.; the compressed-air being supplied by four Ingersoll-Rand two-stage compressors. These compressors operated at 200 lb./sq. in., and each had a capacity of 375 cu. ft./min. From the compressors, the process air was passed, via safety valves, to a Tilghman air booster operating at 220 lb./sq. in. and having an output of 900 cu. ft./min. Strain gauges, to measure stresses and strains building up inside the reactor vessel during the test, were supplied and sealed by Lloyd's and, in a specially constructed control room, all such strains were registered. At the conclusion of the test, Lloyd's accepted the vessel on behalf of the Central Electricity Generating Board.

The earlier stress-relieving of the vessel involved the dismantling of internal scaffolding and the fitting inside the vessel of a network of busbars and sheathed radiant heaters to distribute the 2,000-kW power supply in order to attain the required temperature range of 575-650 deg. C. Power was obtained from the site electricity supply. Simultaneous with these internal preparations, all external surfaces of the vessel were insulated with fibre-glass lagging; thus, heat loss was kept at a minimum. Reaching the required stress-relieving temperature range took two days and then the vessel was allowed to soak. Cooling could not be precipitated, and it was 14 days before the vessel returned to atmospheric temperature.

A wide variety of instruments were employed during the stress-relieving operation, which made possible the measurement of changes in shape of the vessel at various temperatures. More than 300 thermocouples were positioned inside the reactor, the whole stress-relieving operation being regulated from a central control room. Additionally, observation points were built around the perimeter of the reactor from which reactions inside the vessel were seen. Equipment installed



(Left) Top dome of No. 1 reactor pressure-vessel at Berkeley, during preparation for pneumatic test of the vessel—the largest in the world ever to be stress-relieved and pneumatically tested. (Right) Interior of vessel showing diagrid fitted with heaters for stress-relieving main vessel and diagrid. Barrel heaters on walls of vessel can also be seen.

in the control room included temperature controllers, multi-point temperature recorders, indicators and an inter-communication system by which direct contact could be maintained with the observation posts.

The second reactor vessel has already attained its full height of 80-ft., and while work continues on this unit, the associated heat-exchangers are being assembled on site. For stress-relieving the No. 2 reactor pressure vessel many of the techniques described above will be used.

Air Pollution and Fuel Efficiency in the Australian Brick and Heavy Pottery Industries

The high-volatile N.S.W. coals used in many brick kilns in Sydney and neighbourhood have for years been the cause of heavy air pollution. Recently, Mr. R. P. Murphy (Fuel Engineer to the Joint Coal Board) and Mr. J. L. Sullivan (Scientific Officer, N.S.W. Department of Health), have developed a method of hand-firing the kilns which reduces smoke emission to an acceptable level.

The normal method of firing is to slice the fire and then to place coal to the back of the fire-hole and along the bars, closing the fire-hole at the mouth with "green" coal. The "green" coal at the back of the fire-hole volatilises quickly, owing to the high fuel-bed temperature, but it is impossible to consume the smoke, because with this method of firing the secondary-air is reduced to a minimum. It takes 45 min. to slice and feed a 20-hole kiln, and during the full firing-period (the kilns are fired three times every eight hours) heavy smoke emission occurs for more than an hour after each firing.

In the improved procedure (known as "split-firing") the fire is cleaned and sliced and the residual coke pushed to the back of the fire-hole to maintain a bed thickness of 12 in.-14 in. at the end of the fire-bars. Coal is then placed on the fire-bars, commencing about 12 in. from the inside wall of the kiln, but no coal is thrown to the back of the fire-hole. Five shovelfuls of coal are placed in each hole and a large opening left about the fire to allow sufficient secondary-air to pass over the fire-bed and consume the smoke. Sufficient primary-air is admitted for correct combustion.

Following this procedure, it takes 25-30 min. to fire the 20 holes. After a further 10 min. an additional three shovelfuls of coal are fired near the mouth of each hole, to reduce the inflow of secondary air.

The N.S.W. Department of Health is endeavouring to secure a reduction in air pollution, particularly in the Sydney area, by advocating the adoption of improved firing techniques such as that which is here described. Already, a reduction in the fall-out in city areas from 25 to 21 tons/sq. mile/month has been achieved. This improvement is partly due to better grit and dust collection at power stations, and partly to the greater power output from generating plants situated outside the city.

The Department of Health make regular measurements of smoke haze and of SO_2 content in the atmosphere. The haze coefficient is 1 on the bright, clear days which occur during most of the year in Sydney. At other times, the haze coefficient is of the order of 6, and it is 10 during "smog" periods. The latter figure compares with a haze coefficient of 16 in the worst of the London smog conditions.

The average sulphur content of the air in Sydney is 3-4 parts per 100 million, compared with an average of 11 parts per 100 million. Peak values are: Sydney, 7-8 parts per 100 million; London, 100-133.

The Department of Health has installed smoke recorders near brickworks, and these measure the haze coefficient every hour throughout the day and night. In the vicinity of some brickworks, a haze coefficient of 17-18 is usual. The Department will adopt Ringelmann Shade 2 as the acceptable standard for smoke emission for the foreseeable future, but it is thought that advances in technique will make a higher standard justifiable in, say, 20 years' time.

Measurements to date show that the split-firing procedure does solve the soot-deposition part of the problem, but even when the stack appears to be clear, there may, in fact, be a considerable smoke emission.

A large contract for the supply of two complete electro-dialysis de-salting plants has been awarded by the Air Ministry to **William Boby & Co. Ltd.,** Rickmansworth, who are well-known as water treatment specialists. This British pioneer firm specialising in this unusual technique, which employs an electric "stack" to remove impurities from liquids, is to build one plant for installation overseas, and a skid-mounted mobile unit for despatch to any destination at short notice. The firm have already designed and built a large stack producing 55-tons of fresh water daily from the brackish desert wells near Tobruk. A full research programme is being carried out on the big Tobruk stack, monitored continuously by experiments on a miniature stack at Rickmansworth. The capacity of the firm's design and research unit is to be doubled shortly—and thus considerably increased space and facilities will be available for the firm to pursue their research work into the purification of water and other liquors by electrical processes—the technique having recently received world-wide recognition in view of the pioneer work which Wm. Boby & Co. Ltd. have carried out in co-operation with certain foreign research scientists. Boby's enjoy an establishment of more than 85 years, and covering three generations Mr. Michael Boby, the present chairman and managing director, being a grandson of the late Mr. William Boby, who founded the business.

U.K.A.E.A. Annual Report

THE fifth annual report of the United Kingdom Atomic Energy Authority, covering the period April 1st, 1958 to March 31st, 1959, reports steady progress in both civil and defence applications. The present time is looked upon as a period of consolidation, while the next step is to improve the economics of nuclear power, and intensive work is being carried on to this end.

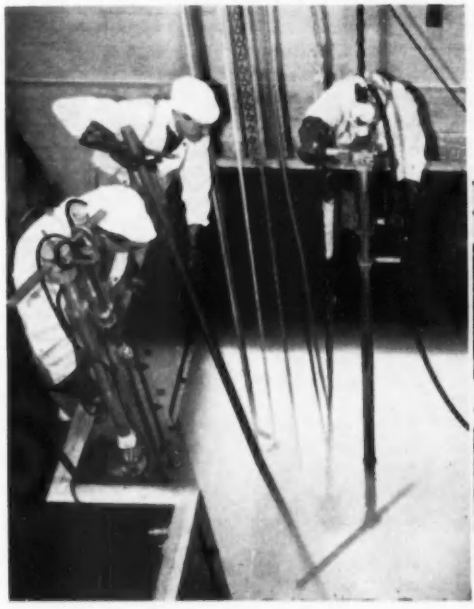
Dealing with reactors—present and future—it is stated that at Calder Hall a thermal output of over 200-MW per reactor is now consistently obtained with electrical generation of 46-MW (gross) and some excess steam production. A considerable amount of experimental work to assist the nuclear power programme has been carried out in the reactors. The excess reactivity has been used to manufacture isotopes and has enabled an experimental programme to be carried out to determine the effects of radiation on reactor materials. Commissioning of the third reactor started at the beginning of 1958. The fourth reactor attained criticality during the year, and will shortly be in full production.

At Chapelcross the first reactor has been commissioned and a thermal output of over 200-MW, with an electrical generation of 46-MW (gross), has been obtained. During the year a number of authority staff have continued to be engaged on improvements in the design of gas-cooled, graphite-moderated natural uranium reactors. The consortia of firms engaged in constructing power reactors have joined in this work as part of the programme of collaboration between them and the authority. Experience with the Calder Hall reactors and work in the authority's materials testing reactor played an important part in an intensive programme to ensure that the fuel in the civil stations now under construction attains an average life of at least 3,000-MW days per tonne.

Preliminary work on the prototype, advanced gas-cooled reactor (A.G.R.), began on the Windscale site on October 1st, 1958. A supporting programme of irradiation experiments has been started which will begin to yield information from the autumn of 1959 onwards, particularly upon the behaviour of beryllium-canned uranium-oxide fuel. The results of this work will be available in time for any necessary modifications to be incorporated in the prototype and its fuel.

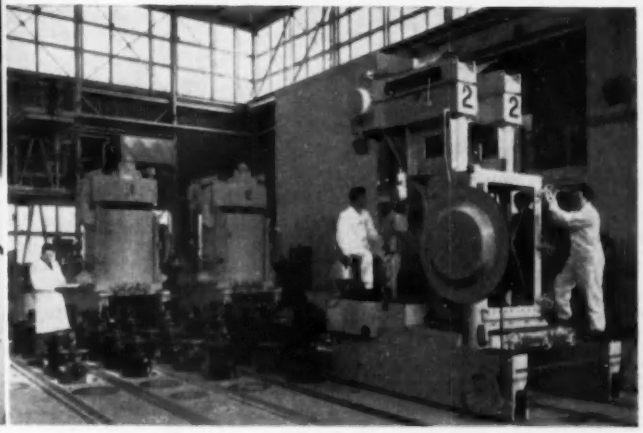
The basic reactor physics problems are being studied by the research group at Harwell, but for the full development of the A.G.R. type of reactor for power generation more extensive experimental facilities are necessary. The most important of these is the zero-energy, high-temperature research reactor, HERO, being built at Windscale. A distinctive feature of HERO will be its flexibility; a variety of core assemblies can be built up to study the reactor physics of different designs. Initially beryllium-canned uranium-oxide fuels will be studied, but later studies will include plutonium-bearing oxide fuels for more advanced applications of the A.G.R. system. The reactor will be heated by hot carbon dioxide so that it can be operated at temperatures up to 500 deg. C.

Steady progress is also reported in connection with the research and development programme for the high-temperature gas-cooled reactor (H.T.G.C.). The immediate emphasis of the present work is on the development of a reactor based on graphite as the moderator and



(Left). A spent fuel element from Calder Hall being carried under protecting water to the "decanning" machine at the Windscale works of the Authority.

(Below). General view of charge floor of No. 1 reactor at Chapelcross showing the fuel element charge and discharge machines. It will be remembered that the first reactor at Chapelcross was commissioned during the year under review.



container for the fissile material. Considerable advances have been made in the production of new types of graphite, both in the experimental plant at Harwell which has produced samples of high density graphite, and by outside contract, where methods of rendering the graphite impervious to gases and fission products have shown considerable promise. An intensive programme was put in hand to determine the resistance of these new graphites to radiation, and small sample fuel elements using these materials were undergoing tests in the research reactors at the end of the year.

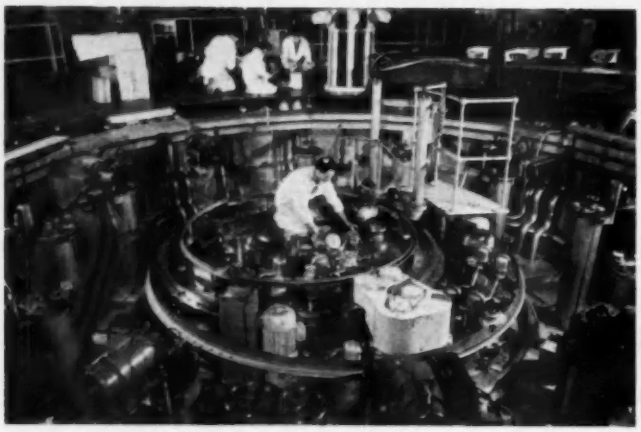
A series of exponential experiments to measure certain basic physics constants of the system was in progress at Winfrith Heath. Construction of the high-temperature, zero-energy experiment ZENITH at Winfrith Heath was almost complete. Physics experiments, initially directed towards elucidating conditions for the reactor experiment, will being later in the current year.

Progress with the study of the gas-cooled, heavy water-moderated reactor system has shown that the use of steam as the coolant in a pressure-tube design would enable evaporators to be used in place of heat-exchangers three times as large. Moreover, the capital cost of the steam-cooled, heavy water reactor should be lower than that of the gas-cooled, heavy water-moderated reactor. Further development potential of the system appears to be considerable.

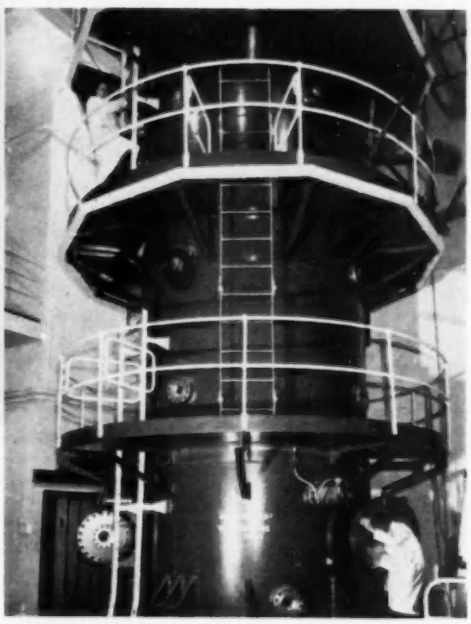
The authority have, therefore, begun to study the design of an experimental plant, which could be modified in due course for electricity generation, in which a 100-MW (heat) experimental steam-cooled heavy water (S.C.H.W.) reactor could be operating by the end of 1962. This plant would contain common services for a second reactor, and if the authority decided to do so, a boiling light water reactor (B.W.R.) could be added in due course.

Because of its simplicity, and its use of light water as a moderator, the potentialities of the B.W.R. have attracted attention in a number of countries, particularly the U.S.A., where enriched uranium can be produced more cheaply than in this country. For use in the U.K., however, the chief disadvantage of the B.W.R. is that, even with zirconium fuel cans, enrichment to about 1½ per cent. is necessary, and a large programme of B.W.R.s would, therefore, require supplies of fissile material in substantially greater quantities and at lower cost than are at present available in the U.K.

The authority's fast reactor at Dounreay was handed over to the operating group in December, 1958. Commissioning was proceeding at the end of the period under review with electrical and mechanical testing of controls and instrumentation. Charging of the liquid metal circuits with sodium potassium alloy was almost complete and the breeder blanket fuel elements had been loaded. This work will be followed by loading with core elements and then by approach to criticality. The reactor should have entered a period of low power testing during the summer of 1959.



(Above). Dounreay fast reactor. The top of the stainless steel pressure vessel is seen in position in the reactor vault.



(Right). General view of part of the 45 ft. high pressure vessel of the tandem electrostatic accelerator at A.W.R.E. Aldermaston.

Information in the report relating to research reactors indicates that during the year the new high-flux reactor PLUTO at Harwell came into operation, and has been brought up in stages to a power of 10-MW (heat). Experiments were made to determine the possibility of increasing the power to 15-MW (heat). Mock-ups of various experimental loops were put in the reactor at low power.

The other high-flux reactor, DIDO, continued to run at 10-MW (heat). New hollow fuel elements were developed for use in both DIDO and PLUTO. These elements were successfully used at high power in DIDO and provide a large fast neutron flux for irradiation experiments.

The materials testing reactor at Dounreay (DMTR) was commissioned and became critical in May, 1958.

The programme of bringing the reactor up to its full power of 10-MW was successfully completed, and the first experimental rigs installed.

At the Atomic Weapons Research Establishment, the light water-moderated research reactor, HERALD, which will be used for neutron physics and radiochemical studies, was in an advanced stage of construction at the end of the period under review.

Throughout the year the zero energy light water reactor HORACE has been the main preoccupation of the reactor team at Aldermaston. This work has proved of value in the basic study of HERALD characteristics. One of the primary objects is to shorten the time taken to run HERALD up to full power.

ZETA, the apparatus for controlled thermonuclear research at Harwell, began working in August, 1957, and during last year improvements were made to the apparatus which enabled a larger current of electricity—270,000 amperes—to be passed through the gas without increasing the supply of electricity stored in its condenser bank. Recently a new condenser bank was installed, capable of delivering ten times as much energy as the original. The new condenser bank will shortly be tested.

The problems raised by the ZETA experiment are, however, such that the authority are to revert to a more basic approach to the problems, and will replace this apparatus by a machine known as ICSE (Intermediate Current Stability Experiment). This fact was revealed at a press conference to introduce the report, when it was also stated that the machine will be a torus, or tube-shaped, like Zeta. It will also make use of the "pinch" effect, whereby the hot hydrogen gas is contracted away from the walls of the torus tube when a current is made to pass through the gas. But, unlike Zeta, the pinched gas will be stable. It will not wriggle about as it did in Zeta. This means scientists will not spend much of their energy trying to keep the pinched gas under control. The inborn stability of ICSE is due to the arrangement of the magnetic field inside and outside the tube.

The current, as with Zeta, will be fed to the machine from condenser banks. But with ICSE the banks will be considerably larger and the current will be delivered not in a few thousandths of a second but in a few millionths.

Controlled thermonuclear reactions

The report also makes reference, under the heading of "controlled thermonuclear reactions," to Sceptre III, a smaller, but similar machine to ZETA, installed at the laboratories of A.E.I. Limited, and to Sceptre IV, an improved version which will begin working in the near future.

A different type of approach is being made at the Atomic Weapons Research Establishment, Aldermaston. The aim here is to achieve high gas temperatures by very rapid compression using a fast rising magnetic field to drive in the gas. The energy is put into the gas before instabilities can develop. To produce the fast rising magnetic field a special type of high voltage condenser bank has been developed which has 200 spark gaps in parallel to overcome the "bottle neck" that arises if a single switch is used. The gaps all fire within a few thousand-millionths of a second and the current builds up at a rate of five million amperes per second. Most of the experiments have been carried out using straight tubes because the simple shape facilitates the experimental techniques and the analysis of results. Experiments so far have demonstrated that although sufficient energy has been put into the gas to heat it to interesting temperatures, these temperatures are not being reached because in some way energy is being lost. The reasons for this loss of energy are being studied at the present time.

Quite a different method of containing and heating deuterium gas is being studied at Aldermaston involving the conception of a new experimental device. In all the other systems described, a gas of deuterium or mixture of deuterium and tritium, is first introduced into either a circular or cylindrical tube and then heated by some means. In this new system, which is known as a mirror machine, one starts with an empty containing chamber. This chamber is surrounded by current-carrying coils generating a magnetic force which will reflect into the centre, and away from the chamber walls, any charged particles of gas. By an ingenious mechanism, the chamber, with its magnetic fields "guarding" all points of exit, is filled with the required gas. Once the particles of this gas are trapped inside the container these magnetic fields may be increased and the gas heated by compression.

One of the great advantages to the scientist of this type of machine is that three essential requirements of a fusion reactor can be carried out separately. These three requirements are the heating of a suitable gas to very high temperatures, containing the hot gas away from the walls of its container, and keeping the gas stable as it approaches these temperatures. These three conditions can be better studied when each of them can be separately controlled and are not dependent on each other.

Other developments

Among other events of importance occurring during the year under review was that on June 7th, 1958, the second Springfields uranium plant was opened. This is designed to satisfy all the fuel element demands of the first civil power reactors, and to provide uranium and uranium oxide fuel elements for experimental and prototype reactors.

Internationally, the most important event of the year was the second Geneva Conference on the Peaceful Uses of Atomic Energy, held in September, 1958. Following the Geneva Conference, arrangements were made for representatives of Commonwealth countries to tour some of the authority's establishments.

An agreement for co-operation between the United Kingdom and Euratom was signed at the Foreign Office on February 4th, 1959. Collaboration between twelve European countries in the development at the Atomic Energy Establishment, Winfrith Heath, of the high temperature gas-cooled reactor experiment (Dragon) is the subject of an agreement signed at Paris on March 23rd, 1959, under the auspices of the European Nuclear Energy Agency. During the year, bilateral agreements were concluded also with Japan and Portugal.

The terms of the first contract for the supply of fuel for a nuclear power station overseas were negotiated when the authority agreed to supply fuel to A.G.I.P. Nucleare for their Latina station in Southern Italy, which is being built under a contract between the Nuclear Power Plant Co. Ltd. and A.G.I.P. Nucleare.

RECENT Equipment AND Accessories

New range of air compressors

A development of their range of oil-cooled rotary "Power Vane" compressors is announced by the Consolidated Pneumatic Tool Co. Ltd., with the introduction of the Class R range for stationary electric operation, together with optional water-cooling of the oil as an alternative to air-cooling. The compressor consists of a simple vane-type rotor enclosed in a sealed compression casing. The rotor is positioned so that it is eccentric with the casing. Sliding vanes inserted radially in longitudinal slots in the rotor create sealed sectors of varying capacity. Each sector increases or decreases in size as the sliding vanes follow the changing contour of the casing. Inlet ports are positioned so that air is taken into the casing when the gap between rotor and casing wall is increasing. As the sector rotates towards the discharge ports, its volume is decreased by the convergence of casing walls and rotor body, and the retraction of the sliding vanes. This decrease in sector volume continues until full compression is reached. The rotary principle results in smooth operation and pulsation-free air delivery. Inlet and discharge porting eliminates valves, and two-stage compression develops high performance without excess loading of parts. The oil is circulated by the pressure differential between the receiver and compressor and is metered by a gear-type pump. Cooling of the oil is effected either in a fan-cooled radiator or, where it is necessary to avoid undue raising of the surrounding air temperature and adequate water supplies exist, by a water-cooled unit. The new range consists of units with capacities of 100, 135, 160, 300 and 510 cu. ft./min. at a pressure of 100-lb./sq. in. (*Consolidated Pneumatic Tool Co. Ltd.*, 232, *Dawes Road, London, S.W.*6.)

Electric actuators

We have received from The Electric Actuator Co. Ltd. details of their range of electric actuators, which the company say are being used extensively for the operation of bunker doors by remote control, and are also being developed for the automatic control of dampers on large boilers of the type installed in power stations. The electric actuator consists of an electric motor in which the turning of the rotor is changed into a push-pull motion by means of a screw. A normal three-phase squirrel-cage motor is built into a tubular frame, the shaft of the motor being a hollow tube provided with an inner thread. The shaft runs in bearings located in the end caps. In both end caps there is a thrust-limit-switch assembly locating the hollow shaft in the mid-position via thrust bearings. Passing through the hollow shaft is the push-pull rod which has a male thread engaging with the thread in the hollow shaft. The push-pull rod is prevented from turning by guide keys in the end caps. Therefore, the turning of the rotor causes the push-pull rod to extend or retract depending upon the direction of rotation of the motor. At the end of its stroke or on overload the push-pull rod becomes stationary, but the rotor continues to turn and screws the hollow shaft back along the stationary push-pull rod, tripping the limit switch and isolating the motor. Therefore, it is virtually impossible to overload the actuator and the thrust is still maintained even though the supply is now switched off. Should it be required to select any intermediate length of stroke it is possible to use external mechanical stops, or alternatively actuators with integral, adjustable, positional, limit switches can be supplied. The actuators are available to suit any 3-phase 50 c/s supply up to 700-volts, and class "H" insulation can be provided for high ambient temperatures. The electric motor is designed for four to ten starts per minute continuous operation or more frequent starting for short time rating. The frequency of starting is dependent upon the load and length of stroke. (*The Electric Actuator Co. Ltd.*, 151, *Swan Arcade, Bradford*, 1, *Yorks.*)

Pressure reducing valves

A new range of pressure reducing valves, in sizes from ½-in. to 2-in., was recently announced by Samuel Birkett Ltd. The valves, known as type-"470," can be applied to all services—steam, gas, air, or liquids—and are generally constructed of heavy bronze castings. The wearing parts, in all sizes, are, however, made of stainless-steel for longer life, and an integral strainer prevents the entry of dirt, scale, or other foreign matter which would cause injury to the seating. Maintenance is therefore negligible, yet, when necessary, it is easy to effect. The valves are suitable for upstream pressures up to 250 lb./sq. in. for steam, or 300 lb./sq. in. for air or water, and operate at total temperatures up to 450 deg. F. The maximum downstream pressure

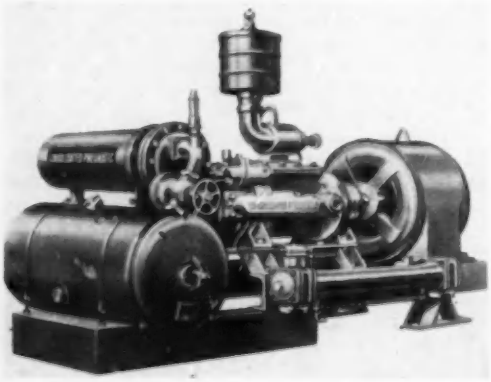


Fig. 1 (left). The new Consolidated Pneumatic 365-REW-2 water-cooled "Power Vane" compressor. Capacities range from 100 to 510 cu. ft./min. at a pressure of 100 lb./sq. in. (Consolidated Pneumatic Tool Co. Ltd.)

Fig. 2 (right). A model from the new range of Birkett "470" pressure-reducing valves, for steam, gas, air or liquids. (Samuel Birkett, Ltd.)

is 150 lb./sq. in. for the ½-in. and ¾-in. sizes and 125 lb./sq. in. for other sizes. Pressure alterations are made by simple screw adjustment. (*Samuel Birkett Ltd., Queen Street Works, Heckmondwike, Yorkshire.*)

High-speed centrifugal pump

Designed specifically for applications where low quantities are required against high pressures, the new high-speed, multi-stage, centrifugal pump produced by Lee, Howl & Co. Ltd., extends their already wide range of rotodynamic pumps. The new pump with 2-in. diam. discharge and 2½-in. diam. suction branches is available with speeds from 2,000 to 2,900 r.p.m. and in stages from 2 to 10.

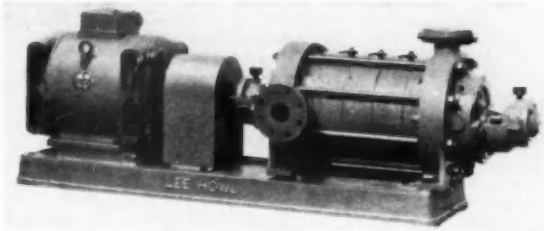


Fig. 3. The new Lee, Howl high-speed, multi-stage centrifugal pump. (Lee, Howl & Co. Ltd.)

The volumes obtainable at the former speed are from 2,400 gal./hr. (116-ft. head—two stages) up to 8,400 gal./hr. (68-ft. head—two stages), and with these volumes with 10 stages the heads achieved are 580 and 340-ft. respectively. The volumes obtainable at 2,900 r.p.m. are 3,600 gal./hr. (244-ft. head—two stages) up to 9,600 gal./hr. (194-ft. head—two stages) and with these volumes with 10 stages the heads achieved are 1,220 and 970-ft. respectively. Impellers are of the single-entry, double-shrouded type, securely keyed to the shaft, and can be of cast-iron, stainless-steel, gunmetal, bronze or other materials as required. The small middle bodies are of close-grained cast-iron, having integral diffusers, which are designed to give maximum efficiency in guiding the discharge from one impeller into the suction of the next. Alignment between each body is assured by machined spigots and recesses and the bodies are accurately located with the suction and delivery covers by similar means. Renewable lead-bronze wearing rings are fitted where the impellers run in the bodies. Renewable lead-bronze inter-stage bushes are fitted with close clearance round impeller spacing sleeves to prevent interstage leakage. The shaft is of ground mild-steel and fully-protected from wear by spacing sleeves between the impellers and by wearing sleeves in both stuffing boxes. The shaft is sealed with gland packing in deep stuffing boxes. At the suction end, the stuffing box is pressure fed to prevent ingress of air whilst the pump pressure on the delivery end stuffing box is relieved to that of first stage pressure. Both boxes are fitted with lantern rings. Grease lubricated ball and roller type bearings are fitted, the ball bearing being capable of absorbing the total axial thrust imposed on the pump rotor. The coupling is of close-grained cast-iron and is of the company's standard non-rigid type, incorporating rubber buffers. The baseplate is of close-grained cast-iron, sized to accommodate the pump, together with motor or engine. The positions of suction and delivery branches are to a certain degree variable according to installation requirements. (*Lee, Howl & Co. Ltd., Tipton, Staffs.*)

Photo-electric flow alarm for industrial Rotameters

From the Rotameter Manufacturing Co. Ltd., we have received details of a new photo-electric flow alarm for use with their industrial metric series Rotameters, types 907 and 914.

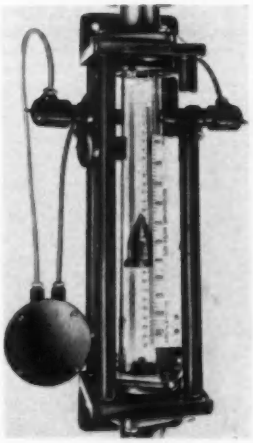


Fig. 4. The new photo-electric flow alarm fitted to a type-907 Rotameter. (Rotameter Manufacturing Co. Ltd.)

The alarm comprises a light source and a photo-conductive cell. Each is housed in an identical black plastic moulding which clamps to diametrically opposite pillars of the chassis. Independent adjustments allow the alarm to be set at the required height and also to align the axes of the lamp and photo-cell centrally through the Rotameter tube. When light from the lamp falls on the photo-cell its resistance falls and allows the passage of sufficient current to operate the relay, coupled to a micro-switch. When the Rotameter float obscures the light, the resistance of the photo-cell increases, thus reducing the current, closing the relay, and operating the micro-switch, which makes one contact and breaks another. As the smallest size of float does not fully obscure the ray of light, a restrictor is supplied to fit over the nose of the photo-cell housing to reduce the diameter of the ray in this case. When used for alarm at minimum flow, alarm will be given when the bottom of the float obscures the light beam, which will not necessarily correspond with the minimum capacity of the instrument. Leads from the lamp and photo-cell are fed to a separate junction box clamped to the chassis. Connection must then be made to the relay box which contains a mains transformer, an alarm relay, and a rectifier. Choice of mains voltage tappings is provided. The lamp is under-run and the length, and therefore the resistance, of the lead from the junction box to the relay box affects the brightness of the lamp; a selection plug in the relay box allows appropriate adjustment of the power fed to the lamp. Automatic or manual reset is optional. The relay and power supply unit is housed in a steel case which measures approximately 7½-in. × 4½-in. × 5-in. and has wall mounting lugs. (*Rotameter Manufacturing Co. Ltd., Purley Way, Croydon, Surrey.*)

Visual flow indicator

An inexpensive and more compact version of the "Telicator" liquid-flow indicator has been added to the range available from Sir W. H. Bailey & Co. Ltd., the sole agents and distributors for the manufacturers, Dukes & Briggs Engineering Co. Ltd. The unit is designed for insertion in pipelines, the ends being threaded ¼-in., ⅜-in. or ½-in. B.S.P.T. and for use with liquids having temperatures up to 80 deg. C. (176 deg. F.). It can be used with high- or low-pressure systems, and with liquids of almost any viscosity. One of the main advantages claimed for the new model over previous models is that it can be completely dismantled for cleaning without breaking the pipe connections. The new unit—known as the K-type—is only 2¾-in. long, and contains a perspex cylinder

housing a rotor which is located by pivots and sprung bearings, so that the flow of a liquid is readily revealed by the revolving rotor. The method of pivoting the rotor is claimed to reduce friction to a minimum, so that the rate of flow of a liquid is hardly affected. (*Sir W. H. Bailey & Co. Ltd., Albion Works, Patricroft, Manchester.*)

Automatic oil-fired boiler

A fully-automatic oil-fired boiler, with new type of burner has been developed by Newton, Chambers & Co. Ltd. Known as the Centramatic 80, it has continuous heat rating of 80,000 B.Th.U./hr. The burner—for which patents are pending—is a fan-pressurised unit incorporating electric ignition and a co-axial type fan. Draught to the burner is automatically regulated. The completely-automatic electric ignition is controlled by the main boiler thermostat, and the burner is either at "high fire" or is "off." This, it is stated, avoids "sooty" combustion and saves fuel. It also avoids uneconomic rates of burning when a reduced output is required on the central heating system, because the boiler always operates at maximum efficiency. Installation of the Centramatic 80 is simplified as the burner is pre-set at the factory to maximum efficiency; the whole boiler, therefore, is completely pre-packaged and only requires to be connected up to the main services on the site. A special link is provided in the wiring circuit which enables a room thermostat or time clock to be connected without any re-wiring process. The Centramatic 80 is an insulated vertical, cylindrical water-tube boiler, constructed of heavy-gauge mild-steel, stove-enamelled in hammer grey and maroon. Compact for its output, it measures 54-in. high and 22¼-in. diam., and has a back flue. (*Newton Chambers & Co. Ltd., Thorncliffe, Nr. Sheffield.*)

Fig. 5. A view of the Centramatic 80, automatic oil-fired boiler, with the outer casing removed. The boiler incorporates a new type of burner, and has a continuous heat rating of 80,000 B.Th.U./hr. (Newton, Chambers & Co. Ltd.)

Smoke density indicator

Ronald Trist & Co. Ltd. have developed a new smoke density indicator—type CSB/6000. This equipment is designed to give continuous indication on a 6-in. scale meter of percentage obscuration of a light beam projected across the path of the flue-gases produced by boilers, industrial furnaces, etc., on to a photoelectric cell of the caesium-silver type, thereby showing the density of smoke being emitted from chimney stacks. Electrical contacts are incorporated to enable an audible warning to be given when the density of the smoke reaches a predetermined level. The optical units are housed in robust weatherproof cast-aluminium enclosures suitable for rigid conduit external wiring; an air-tight access door being provided for routine cleaning of lenses. The control unit is housed in a dust-proof enclosure, ventilated where necessary, with a cast aluminium front assembly suitable for flush or projection mounting. Components having a known limited life are of the plug-in type. The large 6-in. scale remote indicator is calibrated 0-100 per cent. obscuration, having an additional red pointer which can be pre-adjusted to show alarm setting position. Red alarm and green normal lamps together with a 2½-in. calibrating meter are incorporated on the front face of the control unit door. All internal wiring is colour coded to B.S. 2311/1955 to facilitate servicing, this method of connection being the least affected by corrosive atmosphere which can be experienced in boiler houses. Adequate terminal blocks are provided in all units with suitably placed conduit entries for incoming cables. (*Ronald Trist & Co. Ltd., Bath Road, Slough, Bucks.*)

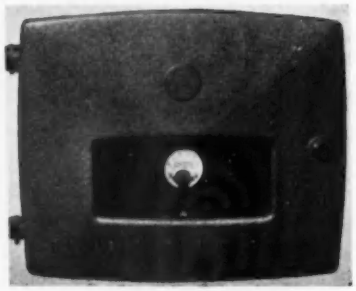


Fig. 6. The new, type-CSB/6000, smoke-density indicator. The 2-in. calibrating meter can be clearly seen. (Ronald Trist & Co. Ltd.)

New synchronous motor

The 415-h.p. salient-pole, synchronous-flywheel type motor shown in Fig. 7, with a Broom & Wade L2000 double-acting two-stage air-compressor, is typical of a range of such motors now being produced by Crompton Parkinson Limited. By mounting the rotor of the motor directly on to the compressor's short and rigid crankshaft, and by placing the stator on its own sole-plate, an extremely compact unit has been achieved. The arrangement greatly facilitates installation and requires very little floor space. These design features, together with a particularly impressive starting performance, are the result of close co-operation between Crompton Parkinson and the manufacturers of air compressor plant. (*Crompton Parkinson Limited, Crompton House, Aldwych, London, W.C.2.*)

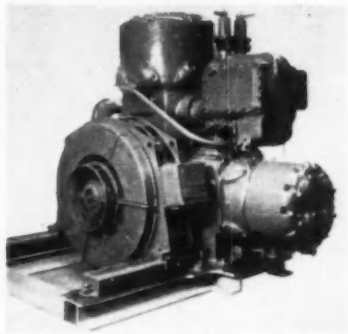


Fig. 7. A Crompton Parkinson 415-h.p. salient pole synchronous flywheel type motor with a Broom & Wade, Ltd., L2000 two-stage double-acting air compressor. (Crompton Parkinson Ltd.)

Oil-burner sequence-control

Photoelectronics (M.O.M.) Limited are now manufacturing a new fully-automatic oil burner sequence-controller combined with flame-failure control and self-checking circuit, for all types of oil-burners. Utilising a photo-resistive photocell, capable of operating the contactor direct, and a synchronous motor timing device this new unit ensures accurate repetitative timing cycles.

The unit is housed in a pressed steel box 8-in. × 4-in. × 4-in. with hinged lid and screw fastening. There is ample room for external connections and the chassis is easily removable for servicing. The photocell is normally mounted in the blast tube of the burner, but housings are available for mounting on the front plate of the boiler if required. The control circuitry has been designed to "fail-to-safety" under every condition. For example:—(a) a safe start relay is incorporated to ensure that the photocell is in darkness when the thermostat calls for heat. If the photocell has been left out in the open at this point the unit will not start up and an external warning bell will be energised; (b) should the cell leads short then the unit will not start up and the warning bell will be energised; (c) should the time clock cut off the supply whilst the motor is moving through the oil period then on re-establishment of the supply the motor will continue its cycle without bringing on the oil and will start a new cycle at the correct time; and (d) two purge periods have been incorporated—the first at the commencement of the day's operations to ensure a clear boiler, and the second from the lockout position to the re-commencement of a new cycle. All time periods can be varied to suit any type of burner and to comply with L.C.C. and B.S.I. specifications. In the case of heavy-oil burners where a purge of the oil-line is required, then an additional cam and switch can be incorporated to energise the solenoid valve for a pre-determined period for this operation to be performed automatically with this same unit. [*Photoelectronics (M.O.M.) Limited, Oldfields Trading Estate, Oldfields Road, Sutton, Surrey.*]

Richard Klinger Limited, on Monday, August 17th, gave a farewell party in London to **Mr. W. E. Hoes** before he left for Australia to open Richard Klinger's new £100,000 factory at Perth. Mr. Hoes will be managing director of this new company. Production of Klingerit sheet jointing and cut gaskets will commence at the end of this year. Later on, the company plans to commence the manufacture of many other Richard Klinger engineering products. The ultra-modern factory now nearing completion will make it possible for the Australian engineering industry to buy world-famous Klinger jointings made in Australia. Hitherto, those industries over there who needed Klinger's high-pressure asbestos jointing had to import it. Klinger's already have manufacturing plant working at top pressure in Austria, Great Britain and Germany, but increasing demands from industry all over the world have absorbed most of the output. As in Great Britain, Richard Klinger (Pty.) Limited will serve such industries as oil companies, automobile manufacturers, nuclear engineers, boiler-makers—in fact, any manufacturer whose products demand high quality jointings. It is now about 65 years ago that Richard Klinger, an Austrian engineer, invented his water-level gauge for boilers. This required a jointing superior to anything then in existence and, after a great deal of research and experimenting, Klinger himself supplied his own need. This second invention, a compressed asbestos jointing material which he called Klingerit, was destined to achieve even greater renown than his gauge. Klinger factories now make both products, and a good many others besides, but the new factory is, we understand, initially to concentrate on the jointing in view of the larger unsatisfied demand for it in Australia. The new factory at Perth itself incorporates many new building techniques. It covers 25,000 sq. ft. Many of the special machines are to Klinger's own design.

* * *

A new leaflet (publication No. W578) issued by **International Combustion Limited,** Nineteen Woburn Place, London, W.C.1, describes the I.C. viscometer for use in oil-burning systems, blending operations, refineries, chemical and similar processes. The information contained in the leaflet deals mainly with the instrument as applied to oil-burner systems.

New British Standard

In this new publication (B.S. 3056: 1959), preferred nominal sizes are specified as a step towards simplification in the range of manufactured fireclay bricks and in their use in furnace construction. Based on a proposed range of sizes submitted by the National Federation of Clay Industries, B.S. 3056 has had the full support of the Fireclay Refractories Industry—whose experience has been that the existing demand for a wide variety of sizes has resulted in short runs from machines and frequent changing of moulds. The range of sizes in this standard forms part of a similar but somewhat more extended range issued by the Scottish Employers' Council for the Clay Industries. Obviously, users' requirements cannot be entirely restricted to the suggested size range—hence the use of the phrase "Preferred sizes" in the standard's title. But it is considered that the selection of sizes offered will meet most normal requirements; and, of course, nothing in the standard should be taken to mean that other types and sizes of firebrick will be unobtainable. The many tables in the 20-page publication are shown in association with "keyed" diagrams. Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 5s. (Postage will be charged extra to non-subscribers.)

* * *

The Central Electricity Generating Board has placed a contract with **Sulzer Bros. (London) Limited** for the supply of the booster and boiler feed pumps for Nos. 1, 2 and 3 generating sets for Northfleet power station (South Eastern Division), and with **Yarrow & Co. Ltd.,** for two 275-MW reheat boiler units for Blyth "B" power station (North Eastern Division).

* * *

Babcock & Wilcox Limited have issued a new leaflet (No. 1644) entitled "Babcock Rack Soot Blower." The Babcock rack soot blower has been designed and developed to clean boiler heating surfaces where the gas temperatures are too high for permanently installed multi-nozzle elements, and where fouling is too severe to be dealt with effectively by the short retractable type of soot blower. The pamphlet gives details of the rack type blower and its control equipment, the latter being of the Babcock-Tate electrical sequence type.

An important order placed with **Metropolitan-Vickers South Africa (Pty.) Limited** by the Electricity Supply Commission of South Africa is for two 100,000-kVA auto transformers for Komati power station. The order was obtained in face of keen competition from Continental and other British manufacturers. The transformers will be manufactured by the A.E.I. transformer division. For transportation to site in South Africa they will necessarily be of special design to meet maximum weight limitations and loading gauges. The transformers will have a voltage ratio at no-load of 275,000/132,000 volts, and will incorporate 22,000-volt delta-connected fully-insulated tertiary windings for a 20,000-kVA load. One h.v. winding of one transformer will be subjected to an impulse test of over a million volts.

* * *

Following their recent receipt of the £750,000 contract for the Willington "B" power station superstructure, **M. J. Gleeson (Contractors) Limited,** North Cheam, Surrey, have now been awarded a £1¼ million contract for the construction of the superstructure for Padiham "B" power station, near Burnley, Lancs. The scheme, to be carried out for the Central Electricity Generating Board (Northern Project Group), includes the construction of a turbine house, boiler house and ancillary structures. Gleesons are at present completing the £1¼ million contract for the foundation work for the project, while completion of the whole scheme is expected to be effected by December, 1962. The engineering consultants are C. S. Allott & Son, of Manchester and London, with Cruickshank and Seward, F.R.I.B.A., as the architects.

* * *

The United Kingdom Atomic Energy Authority have appointed **Mr. J. B. Adams** to be director of a new establishment to deal with controlled thermonuclear research. The work in this field now being done at Harwell, and some of the work now being done at A.W.R.E., Aldermaston, will be moved to this new establishment. **Mr. Adams** is at present director of the proton-synchrotron group of the European Council for Nuclear Research (C.E.R.N.) near Geneva. He will take up his appointment with the Atomic Energy Authority towards the end of 1960. It has not yet been decided where the establishment will be located.

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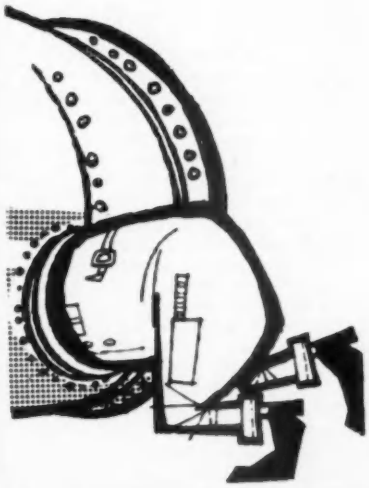

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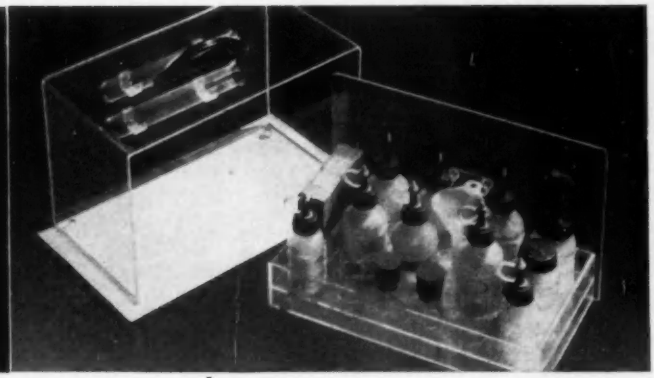

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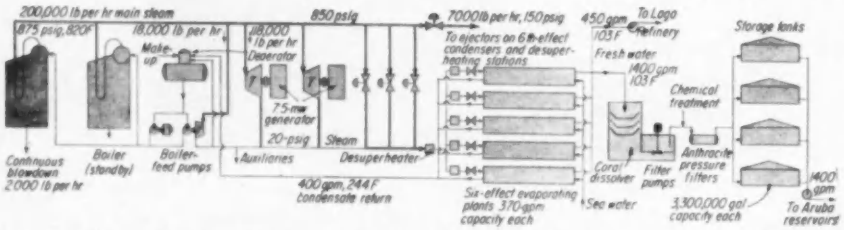
OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Seawater distillation plant in Dutch West Indies

A new seawater distillation plant, with a capacity of 2.25-million gal./day, was recently put into operation on the island of Aruba in the Dutch West Indies. Two 200,000 lb./hr. outdoor boilers supply steam at 850 lb./sq. in. and 820 deg. F. to two back-pressure turbines, each of 7.5-MW capacity, and then, at a pressure of 20 lb./sq. in., to the water plant. The distillation plant has a total of five independent sets of six-effect evaporators. These were supplied by G. & J. Weir Limited, and each has a capacity of 450,000 gal./day. The steam at 20 lb./sq. in. heats the first-effect of each set. The control valve feeds steam at 12 lb./sq. in. to the coils. A pump passes the coil condensate to the deaerating heater at 244 deg. F. The first-effect vapour at 225 deg. F. gives up some heat to preheat the seawater feed and then enters the second-effect heating steam. This process is repeated with lowering temperatures down to the sixth-effect where incoming seawater condenses the vapour; the six effects yielding almost 5-lb. of distilled water for each pound of steam. The distillate is guaranteed not to have more than 10 p.p.m. of total solids, starting with seawater at 35,000 p.p.m. The seawater, being free from floating matter and clean, enters the cycle through ¼-in. mesh stationary monel metal screens. Chlorination at the circulating pump inlets prevents algae growth which fouled and blocked heat-exchanger tubes prior to this treatment. Incoming seawater first cools the distillate and then enters the fifth-effect evaporator shell. Here a ferric-chloride chemical treatment prevents scale deposition in the earlier effects. Water enters the first-effect shell at just below evaporation temperature. A portion distils off and the balance passes to the second shell—and so on to the cycle end where the concentrated brine discharges to waste. About 60 per cent. of the seawater volume evaporates. The final concentration of solids in the brine, about 9 per cent., is still too thin for effective recovery of the minerals. The chemical treatment in the fifth-effect needs additional disengaging surface, so this effect has two shells in parallel. This gives seven vessels in each six-effect evaporating set; a total of 35 vessels in the plant. Each shell is about 11-ft. dia. and 30-ft. long; the total distillation plant occupying an area of about 175 by 300-ft. The ferric-chloride treatment was employed to utilise the 225 deg. F. starting temperature. As previously stated the chemical enters the plant at the fifth-effect temperature of 149 deg. F., and prevents scaling at higher temperatures. Ferric chloride has not been widely used because of its corrosiveness and high cost. In the Scalemaster process of G. & J. Weir Limited, incorporated at Aruba, two electrolytic tanks produce ferric ions in proportion to the seawater flow to the evaporators. By hydrolysis, the ferric ions react with the calcium carbonate in the seawater and form a ferric hydroxide sludge, which is non-scale forming. Both boilers at Aruba are oil-fired. The steam cycle has no regenerative heaters. A deaerator heats the condensate returning from the evaporators, and make-up, with the 20 lb./sq. in. exhaust steam. The deaerator has a 10,000-gal. storage tank. Pressure-reducing stations are designed to break down the 850 lb./sq. in., 820 deg. F. to 20 lb./sq. in. and 264 deg. F. Higher temperatures would cause scale to form in the evaporators. While the pressure drops in one step through a double-seated valve, actuated by a power cylinder, the temperature drops in two stages. The first is a steam-atomised water spray in the 36-in. main exhaust heater to the water-distillation units; this drops the steam to 350 deg. F. Then, at each of the five evaporating sets, a venturi-type desuperheater limits the final temperature to not over 5 deg. F. above saturation temperature. After treatment, the Aruba distillate has a slight acidity with a pH about 5.6. The nearly complete absence of salts gives it a flat taste, which is improved by running the water over beds of broken coral gathered from the local beaches. This treatment: (1) aerates, (2) neutralises and (3) restores some of the minerals by solution from the coral. An automatic pH control system adds soda ash for full alkalisation. The water is fluorinated before entering the four 3.3-million gallon storage tanks. The distillate being completely bacteria free needs no chlorination. It is believed that this plant is the largest of its type in the world. (*Power*. Vol. 103, No. 7, pp. 68-70.)



Diagrammatic arrangement of the combined power and distillation plant on Aruba in the Dutch West Indies.

Steam drum for nuclear power station

The Foster Wheeler Corporation of America recently supplied to the Commonwealth Edison Company's new Dresden nuclear power station a primary steam separating drum. The finished drum, measuring 104¼-in. dia., 67-ft. long and weighing 187-tons, was fabricated in eight major sections. These comprised two

forged closure-heads and six 10-ft. long cylindrical sections. Each cylindrical section was in turn fabricated from two half-shells. The half-shells were cold-formed on an 8,000-ton capacity press from SA-302-B material, measuring 4-in. thick by 129½-in. wide by 172-in. long and weighing 13-tons. Plates were formed to conform to a full-size template. The longitudinal weld grooves were then machined on a 10-ft. by 10-ft. by 40-ft. bed planer. The two half-shells were set up to form a cylinder and moved to the automatic submerged-arc welder. The inside seam was also welded by the same method, being carefully back-gouged to sound metal prior to this operation. At this point, the shell was stress-relieved to relieve stresses induced in the forming and welding processes. Drum ends were machined to the standard weld groove geometries for circumferential or girth seam welding. The design of this primary steam drum required a ¼-in. thick stainless-steel cladding over the entire interior of the vessel. The six cylinders were clad individually with a ½-in. layer of stainless-steel; the process used for this operation being the automatic submerged arc method. Individual cylinders were then machined to provide the desired surface finish and necessary dimensions. The cylindrical sections were then joined together in two groups of three. These two sections were in turn joined together and one closure-head assembled. The assembly at this stage was more than 60-ft. long, 104¼-in. dia. and weighed in excess of 150-tons. Nozzle openings were then cut in the drum and a total of 36 large nozzles were installed to serve the risers, downcomers, steam outlets and safety valves for the steam drum. These forged-steel riser nozzles, measuring 16-in. o.d., were clad with ¼-in. stainless steel. The internal equipment was then installed, the remaining head assembled, and the final stress relief, and hydrostatic tests with specially filtered water were carried out. The drum was then ready for shipment. During this fabrication cycle, which is basically the standard steam drum procedure, several problems developed which were unique. The equipment to be installed in the drum presented a difficult handling problem because of its size. Dry boxes, manifolds, driers and separators were fabricated as complete sub-assemblies prior to final assembly. A temporary monorail with an electric hoist was installed in the top of the drum to lift and position the larger items, particularly the manifolds. All internal equipment had to be fitted in the drum prior to assembly of the remaining closure-head since the size of these components did not permit their being fitted through the manhole openings. Items adjacent to the open end of the drum had to be sandwiched over, around and underneath the other components to provide space for the firebrick dam erected inside the drum on the final stress relieving operation. After the remaining closure-head was installed, the girth seam was finally stress-relieved, an operation for which it was necessary to localise the heat affected area, since the heat would have warped the assembled internal components. To prevent this, a fibreglass curtain was erected to seal off the area to be treated from the remainder of the drum. This prevented the drum from becoming contaminated by dirt or dust from the insulating materials. The portion of the drum to be heated was placed in the furnace and a dam of magnesia Supreflex block and cement was then erected inside and outside. In this manner, the final girth seam was stress relieved without inducing distortion in the assembled internal components. (*Heat Engineering*. Vol. 34, No. 2, pp. 23/25.)

Combustion Chemicals Limited, Elcot House, 33, Dorset Square, London, N.W.1, have introduced a range of Premium fuel oils, which are regular grade residual fuel oils that have been pre-treated with Desulfurol fuel improver and sulphur inhibitor. These new Desulfurol-treated fuel-oils are now available to all residual fuel oil users in London and the Home Counties, and the service will shortly be extended to cover the whole country. They will sell at the same standard schedule prices as apply to existing regular grade residual fuel oils. The oils are supplied in three grades—200, 950 and 3,500 sec. Redwood No. 1. As the oils have been pre-treated with Desulfurol fuel improver and sulphur inhibitor, they are sludge free and give better atomisation due to the reduced surface tension—the spreading property is 2½ to 3 times that of the equivalent untreated fuel oil. Combustion efficiency is increased, and lower pre-heat temperatures can be used.

* * *

A new leaflet available from **The General Electric Co. Ltd.,** Magnet House, Kingsway, W.C.2, provides a guide to the application, construction, operation and performance of their Twyntorq motors. These are special machines, which, by the transmission of "static" torque or power can be applied to signalling or indicator duties and remote control systems. They can also be used to provide correction power for the purpose of synchronising equipment powered by individual driving motors with no mechanical interconnection.

The Italian **Comitato Nazionale per le Richerche Nucleari** has purchased for a nominal sum from **William Boby & Co. Ltd.,** Rickmansworth, as a research project, one complete electrodialysis stack, of the type pioneered by the British firm, for experiments in decontamination of nuclear effluents. William Boby & Co. Ltd. have received world-wide attention recently for their pioneer work in co-operation with Dutch and other foreign research scientists into the purification of water and other liquors by electrical processes. A Boby designed and built stack at Tobruk is currently producing 12,000 gal. (55 tons) per day, of fresh water from brackish desert well waters. A similar basic research stack has been supplied by Boby's to A. Reyrolle & Co. Ltd., Hebburn-upon-Tyne, for metallurgical research.

* * *

Holland & Hannen and Cubitts (Scotland) Limited are to build a £100,000 four-storey office block for **Richardsons Westgarth (Hartlepool) Limited,** adjoining the company's existing head office at Princes Street, Hartlepool. Both Cubitts and Richardsons Westgarth are associated with Atomic Power Constructions Limited, for the construction of Trawsfynydd nuclear power station, North Wales. Completion of the new office block is scheduled for July, 1960, with erection of the steel-framed building speeded up by the use of patented wall cladding, floors and roofing. The architects are L. J. Couves & Partners.

Mr. Giles Newton, chairman of The Cape Asbestos Co. Ltd., stated in the Group's annual report, published recently, that products of the Group increased 8 per cent. in 1958. Cape Asbestos produce raw asbestos from their mines in South Africa, and their principal manufactured products are "Caposite" asbestos thermal insulation materials, "Rocksil" rock wool insulation, "Asbestolux" asbestos insulation board, "Marinite" asbestos sheet, and "Capasco" brake and clutch linings. Sales of the parent company's products increased, with a marked improvement in marine business. Export sales accounted for 17 per cent. of the parent company's turnover. Agreement has been reached with two well-established firms in Argentina, and with the Johns-Manville Corporation, to manufacture asbestos products in that country. The amount of crude asbestos sold in South Africa had been slightly greater in spite of Russian competition, while the peak of capital development in the South African mines had been passed. Expenditure in 1958 had been less than in 1957 and would be less again in 1959. Ore reserves had been much increased, but development so far showed there was no prospect of easy mining ahead. Mr. Newton viewed the prospects for the current year with some degree of caution. But the Group had a great source of strength in the widely varied scope of its manufacturing activities and there was every reason to expect that many of their operations would continue their steady and remunerative expansion.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Mountings for steam or gas turbine units

This invention relates to mountings for steam or gas turbine units. In Figs. 1, 2 and 3 the group of machines and apparatus consists of a high-pressure turbine (1), a low-pressure turbine (2), a heat-exchanger (3), a cooler (4), and a compressor (5). The high-pressure turbine (1) and the compressor (5) are built into a common housing. The machine and apparatus group (1, 2, 3, 4 and 5) forms a unitary, rigid and self-supporting unit. The working medium entering the compressor (5) is comparatively cold. If an inner casing insulated from the outer casing is provided for the high-pressure turbine (1) in the usual manner, the complete casing remains comparatively cold. Towards the low-pressure turbine (2), however, the temperature of the group gradually increases. Therefore, different temperatures and consequently different expansions are produced at different points. The mounting of the group consists of four supports, two of which are designated at (15) and the other two at (16). The supports (15) each consist of a leaf spring (17), which is reinforced in the middle portion by laterally attached elements (18). The leaf springs (17) are secured at their upper ends substantially at the height of the axis at both sides of the heat-exchanger (3) at points (19) in the region of the hotter end, and their bending axis extends parallel to the machine axis. The lower ends of the leaf springs are clamped at points (20) in a bedplate (21). Owing to the reinforcements (18) the supports (15) are prevented from buckling, by the load of the structure to be supported between the reinforcements (18) and the fixing points (19 and 20). However, there are still non-reinforced parts (22) on the leaf springs, and these act as leaf hinges. Since the bending axis of these hinges extends parallel to the machine axis, they do not permit any axial displacement of the machine and apparatus group (1-6) at the securing points (19). Owing to the yieldability of the leaf hinges (22), however, the heat-exchanger (3) between the two fixing points (19) can expand freely in a direction at right-angles to the axis. The heat expansion of the comparatively hot part of the group is therefore not impeded. In order to prevent lateral displacement of the machine axis, a guide key (23) is provided on the axis of the bedplate (21), which key engages in a groove of a downwardly-projecting part (24) of the heat-exchanger (3). This key permits a free displacement of the underside of the heat-exchanger in a vertical direction, but not in a lateral direction. The supports (16) are fixed at their upper ends to points (25) on either side of the comparatively cold machine housing (6), and at their lower ends to points (26) on the bedplate. The supports (16) also each consist of a leaf spring (27) which is reinforced in the middle by elements (28) arranged on both sides. Non-reinforced parts (29) are, therefore, left between the reinforcements (28) and the fixing points. The bending axis of the portions (29) is at right-angles to the machine axis. The supports (16), therefore, permit free displacement of the housing (6) in an axial direction, so that the heat expansion of the group of machines and apparatus between the axial fixing points (19) and the positions (25) is not impeded. As regards the comparatively cold machine casing (6), however, there is practically no transverse expansion. The stressing of the leaf springs in the direction at right-angles to the bending axis of the hinges (29) is, therefore, unimportant. *British Patent No.* 814,312 *issued to A. Guer Technische Studien. Complete specification published June 3rd, 1959.*

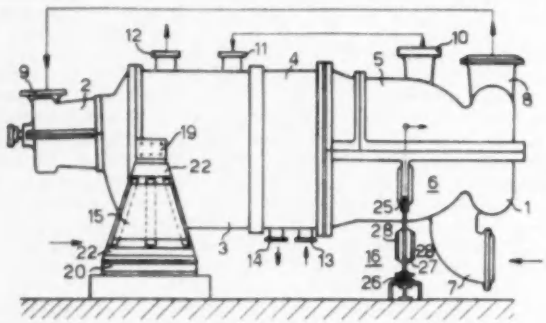
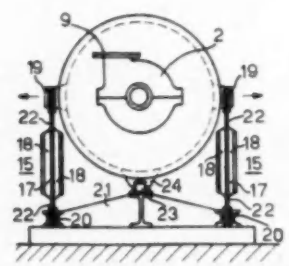


Fig. 1 (left). British Patent No. 814,312



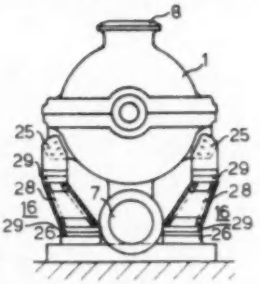


Fig. 2 (right). Fig. 3 (extreme right). British Patent No. 814,312.

Forced flow once-through steam generator

The principle of this invention relates to forced-flow once-through steam generators which operate preferably at or above critical pressure, and which comprise two or more reheaters located in high-temperature zones. In such generators, difficulties arise when the generator is to be set in operation or is to operate under a low load with no reheating being carried out. Since high steam temperatures are generally required in the reheaters, the latter are disposed in a relatively hot flue-gas zone. Therefore, when the generator is

started, the reheaters are particularly exposed to danger. Cooling of the reheaters also entails certain difficulties since the danger of water-hammer is to be expected during cooling. A method of starting such forced-flow once-through steam generators which are operated at or above critical pressure, and which comprise a number of reheaters, is known in which the second stage reheater disposed after the first stage reheater is cut off from the throughflow of

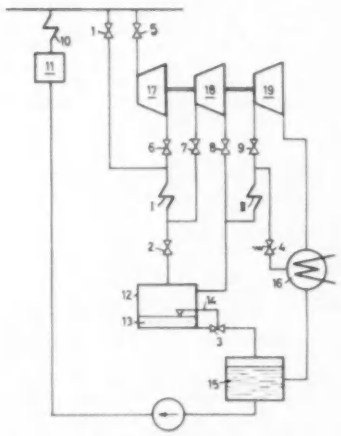


Fig. 4. British Patent No. 815,406.

the working medium during starting, or while the generator is under low loads when no reheating is carried out. It is the main object of the invention to obviate the disadvantages involved in disconnecting the second-stage reheater from the system during starting operation. In Fig. 4 the valves provided are designated by (1 to 9). In one of two starting methods envisaged the pressure in the superheater (10) associated with the boiler (11) is maintained above the critical value by means of valve (1) which is kept only partly open. The pressure in the first-stage reheater, which is indicated at (1), is maintained at the maximum operating pressure of, for example, about 100 atms. gauge by means of valve (2) which is also kept only partly open. Steam flows from the valve (2) into a separating vessel (12) while the water (13), which is separated in it, flows through a valve (3) under the control of a level regulator (14) into a feedwater container (15). The steam liberated in the expansion in the separating vessel (12) flows through a second stage reheater (11) and through a valve (4), which is spring-loaded to maintain a pressure of, for example, about 12 atms. gauge in the reheater (11), into a condenser (16). A satisfactory cooling of the reheater (11) is thereby effected. In the other starting method, the valves (1 and 2) are initially fully-open. The generator is thus started at a minimum operating pressure. In this case, the pressure is maintained only by the valve (4), which normally opens when a predetermined pressure, for example, about 12 atms. gauge, is exceeded. In both methods, as soon as the superheated steam temperature is reached in the final superheating stage, the valve (1) is closed and the valve (2) is then also gradually closed, and the turbine comprising the high-pressure stage (17), the intermediate-pressure stage (18), and the low-pressure stage (19), is started by opening the valves (5 to 9). The spring-loaded valve (4) may, of course, be replaced by a counter-weighted valve and, in addition, the pressure of the turbine oil control system may be allowed to act thereupon. If so, the control oil pressure of the turbine acts in such a manner on the valve (4) that the latter is closed when the valve (9) is opened, and is opened when the valve (9) is closed. Thus, for example, if the load on the turbine suddenly drops to about zero, the steam flowing through the reheater (11) is discharged into the condenser (16) due to the valve (9) closing and the valve (4) opening, since otherwise the speed of the turbine becomes excessively high and the turbine is endangered. *British Patent No.* 815,406 *issued to Siemens-Schuckertwerke A.G. Complete specification published June 24th,* 1959.

Water-tube boiler

This invention relates to water-tube boilers comprising a transversely disposed steam and water drum and a transverse collector header at the same level as the drum. Water-tube boilers are known in which by means of special return-flow tubes some of the circulation water is returned to the heated tube system by by-passing the drum. This pre-separation and direct return flow of circulation water considerably relieves the steam drum as regards the separation of steam and water. The invention covered by this patent aims at increasing still further the quantity of the circulation water which is returned directly to the heated tube system through return-flow tubes. This is to be accomplished by arranging in the longitudinal tubes which connect the transverse header and the drum, return flow tubes which start from the longitudinal tubes and open into lower water distributors. A water-tube boiler with transverse steam and water drum (1) is shown in outline in Fig. 5. From the drum (1) down-comer tubes (2) supply boiler water to a front distributor (3), lower longitudinal distributors (4) and rear distributor (5). The front wall steam generating tubes (6) open into the transverse header (7).

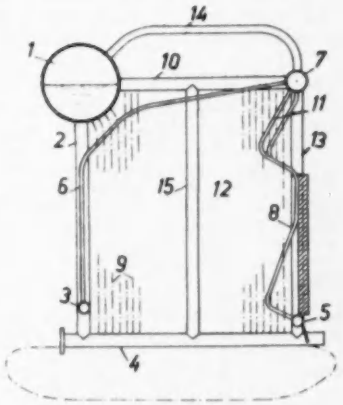


Fig. 5. British Patent No. 814,516.

The rear wall tubes (8) also discharge into header (7). The side-wall tubes (9) proceed from the lower distributors (4) and open into two upper longitudinal headers (10) which connect respective ends of the header (7) with the corresponding ends of the drum (1). In order to return the water separated in the header (7) to the lower distributors by-passing

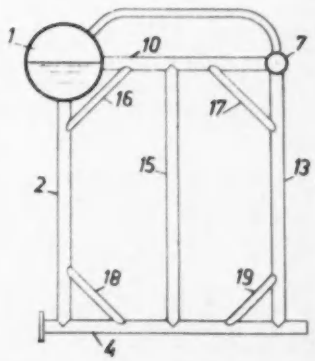


Fig. 6. British Patent No. 814,516.

the drum, return-flow tubes are provided which feed circulation water to the lower distributors. The steam flows through the upper longitudinal headers (10) to the drum, but part of it can also flow out through overflow tubes (14). The circulation water cannot flow from the side-wall tubes (9) through the return flow

tube (13), since the header (7) is under higher pressure than the drum, and it would also have to move in opposition to the steam-flow. A further return-flow tube (15) is arranged between the transverse header (7) and the drum (1), the return-flow tube connecting the headers (10) to the longitudinal distributors (4). The boiler frame structure, formed of tubes, including the steam and water drum but omitting the heated evaporator tubes is shown in Fig. 6. Arranged in this case also between the drum (1) and the transverse header (7) are return-flow tubes (15) which proceed from the longitudinal header (10) and open into the longitudinal distributor (4). For the further direct return of boiler water, further return-flow tubes proceed from the longitudinal header (10), the tubes (16) from directly in front of the drum (1), and the tubes (17) directly behind the transverse header (7). The tubes (16) extend diagonally from the header (10) into the downcomer tube (2) and the tubes (17) similarly from the header (10) into the return-flow tube (13). *British Patent No. 814,516 issued to H. Vorkauf. Complete specification published June 3rd, 1959.*

NEW BRITISH STANDARD

This new publication, (B.S. 3082) "Mechanical testing of steel at elevated temperatures," forms Part 1 in a series of British Standards which will deal with the mechanical testing of steel at elevated temperatures. It is based on the work undertaken by Technical Committee 17 (Steel) of the International Organisation for Standardisation as has been tentatively approved by all the member countries represented by that committee. It is hoped that the series will help to facilitate the comparison of different steels at elevated temperatures and to unify the methods by which the data are obtained. In this part, definitions for gauge length, stress and proof stress are followed by requirements for the test piece. Consideration is given to the limits within which the heating apparatus must operate, and to the method for measuring the temperature. Other requirements deal with the determination of elongation and with the rate of testing. Copies of this British Standard can be obtained from British Standards House, 2, Park Street, London, W.1. Price 3s. (Postage will be charged extra to non-subscribers.)

* * *

A completely new range of pneumatically-operated screwdrivers and nut-setters, produced by the **Airetool Manufacturing Company,** Springfield, Ohio, is described in the company's new illustrated bulletin No. 68. Copies of the bulletin can be obtained from Airetool Manufacturing Company, 328, S. Center Street, Springfield, Ohio, U.S.A.

* * *

Publication No. G.14051, issued by **A.E.I. Heavy Plant Division,** describes a new brushless, high-speed marine alternator, now available in a range with ratings up to 1,000-kW.

* * *

New publications:—List 186 (a 20-page brochure), and Supplement "A" issued by the **Cambridge Instrument Co. Ltd.,** describes the Model "DE" electronic recorder, a high-performance instrument of proven reliability with a full-scale response speed of better than 2 sec., a minimum range of 1 mV, a sensitivity of better than 1 μV, and an overall accuracy of better than $\pm$ 5 μV. It forms an integral part of the company's complete equipment for the measurement of temperature, gas concentration, pH, conductivity of solutions, dissolved oxygen in feedwater, strip width and thickness, radiation intensity, etc., and can be supplied for numerous other applications in industry and science.

Publication No. 321 issued by **Electrothermal Engineering Limited,** 270, Neville Road, London, E.7, describes armoured heaters for the pre-heating and stress relieving of welds and other forms of heat-treatment, with working temperatures up to 1,472 deg. F. The heaters are produced in standard lengths for safe use on 50-V, 75-V and 150-V. They are of $\frac{1}{16}$-in. diam. and are constructed of a nickel chrome resistance wire, suitably insulated, and enclosed in a flexible nickel alloy sheath. This construction allows for many applications to pipes, vessels, and flat or curved plates at maximum temperature without impairing the flexibility or heating efficiency of the heaters.

* * *

We have received from **Auto-Klean Strainers Ltd.,** Lascar Works, Hounslow, Middlesex, leaflets describing their 30L2, 30M3 and 30M4 self-cleaning filters. These have been developed primarily to meet the need for defined mesh full-flow filtration down to 0.0015-in. in the lubricating oil systems of high and medium-powered turbine and diesel plant. The new range of filters handles flows up to 11,200 gal./hr. and 5,400 gal./hr. with defined meshes of 0.003-in. and 0.0015-in. respectively.

* * *

The Morgan Crucible Co. Ltd., Battersea Church Road, London, S.W.1, have published a most interesting leaflet entitled "Your Crucible," which is intended as a general guide for the care and use of crucibles. It has been compiled to help the foundryman get the best from his crucibles and the maximum efficiency from crucible melting.

* * *

The latest publication (Bulletin No. 12) issued by **The Incandescent Heat Co. Ltd.,** Cornwall Road, Smethwick, Birmingham, includes details of their range of processing equipment for the electrical industries. Among the units described are those for coreplate varnishing; transformer drying; transformer spraying; continuous varnish impregnation; paint drying; battery plate drying; and bitumen coating.

* * *

We have received from **A. B. Scorer Limited,** Ford Lane, Pendleton, Salford, 6—a member of the Hodgkinson Group of Companies—a new eight-page illustrated brochure describing their range of Scorer refuse destructors. The standard range of units can handle from 80-750 lb./hr. of general refuse. Where required the heat produced can be utilised by the fitting of steam boilers or water-heaters.

A sales agreement has been signed between the **American Machine and Foundry Corporation,** U.S.A., and **William Boby & Co. Ltd.,** Rickmansworth, for the American firm to market Boby electrodialysis stacks in the United States, Canada, and elsewhere in the Western Hemisphere excluding British territories.

* * *

Honeywell Controls Limited announced that they are sole representatives in this country for MacDonnel & Miller Inc., of Chicago, U.S.A., who are manufacturers of boiler water-level controls and low-limit boiler safety devices. **Mr. D. Richards,** the Honeywell sales manager responsible for marketing the new products in this country, points out that the equipment should be of particular interest in the ranges of combined feeder control and low-water cut-off instruments, suitable for boiler pressures up to 250 lb./sq. in. All models out of the range of over 30 boiler water-level and safety controls will be available in the U.K. shortly. The choice of stocks to be established will depend very largely on the individual needs of boiler manufacturers in this country. Enquiries should be made to **P. W. Kingsland,** Honeywell Controls Limited, Ruislip Road, Greenford, Middlesex.

* * *

A new leaflet available from **Vokes Limited,** Guildford, Surrey, describes their "Super-Vee" air-filter panel. The filter utilises a synthetic fibrous medium, impregnated with a recently developed and improved adhesive which ensures high filtration efficiency and long life. Standard sizes are from 10 by 10-in. to 20 by 25-in., with capacities from 250-1,250 cu. ft./min.

* * *

The British Thomson-Houston Co. Ltd. recently issued a publication (F.111029) on Selsyns. The author, Mr. S. A. Choudhury, B.Sc., A.C.G.I., deals first with some aspects of the principles of operation of Selsyns and design calculations of torque—useful information to have at the layout stage of new installations. Following a description of the various types of Selsyn, the author considers in detail many of the practical questions which are often asked by engineers concerned with the application of Selsyns to various control schemes in different industries. This 48-page publication should prove to be a welcome addition to the somewhat sparse literature available on the subject. Copies of the booklet may be obtained by professional engineers, upon application to B.T.H. Publicity Dept., Rugby.

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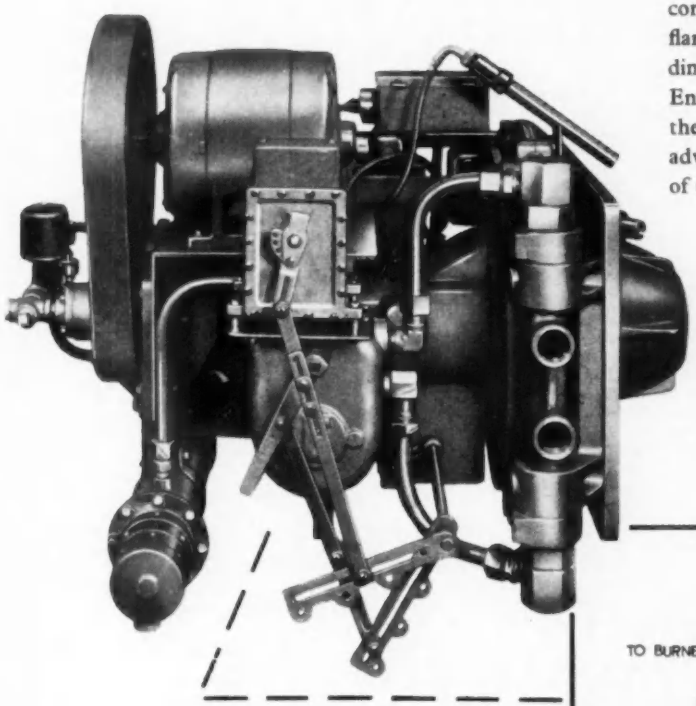

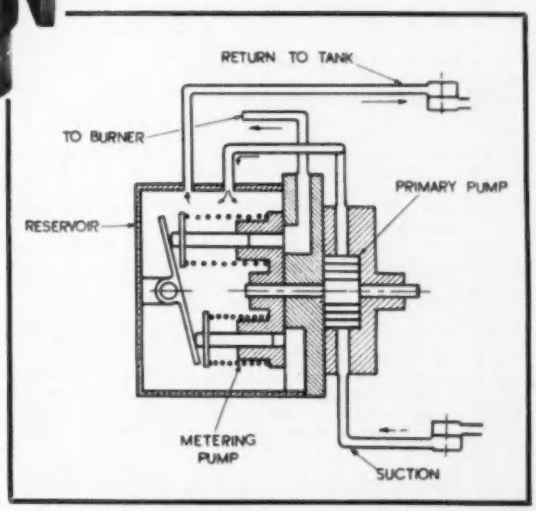

The Measured Rate Metering Pump is exclusive to Swinney-Enterprise burners. Regardless of grade, viscosity or temperature of fuel the metering pump will provide the correct flow of fuel to ensure precise air/oil ratio and efficient combustion.

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NOTES Personal AND Industrial

The Minister of Power has reappointed **Mr. D. B. Irving,** B.Sc., M.I.E.E., as chairman of the London Electricity Board for a period of five years from July 1st, 1959.

* * *

Mr. E. A. Anderson, A.M.I.Mech.E., deputy station superintendent at Portsmouth power station, Southern Division, C.E.G.B., has been appointed to a similar position at the division's Marchwood generating station. Previously, Mr. Anderson was, for 2½ years, mechanical maintenance engineer at Marchwood.

* * *

Mr. L. Dobson, engineering director, Imperial Chemical Industries Limited, Plastics Division, left I.C.I. Limited at the end of August and joined the board of Simon-Carves Limited.

* * *

Ruston & Hornsby Limited, Lincoln, announce that **Mr. Geoffrey W. Bone,** M.A. (Cantab.), M.I.Mech.E., M.I.Mar.E., etc., a director, has assumed responsibility for the company's engineering policy, and for that of their associate, Davey, Paxman & Co. Ltd., Colchester. Another Ruston appointment is that of **Mr. J. R. Bergne Coupland,** J.P., as an assistant managing director. He will act jointly with the present assistant managing directors, **Mr. E. R. Jones** and **Mr. C. T. Alderson.**

* * *

The Electricity Council have appointed **Mr. Lawrence Arthur Corney,** B.Sc. (Eng.), A.M.I.E.E., to be their chief safety officer. Mr. Corney, who was hitherto deputy chief safety officer, succeeds **Mr. H. Midgley,** who retired at the end of August.

* * *

The United Kingdom Atomic Energy Authority announce the appointment of **Air Chief Marshal Sir Claude B. R. Pelly,** G.B.E., K.C.B., M.C., as Member (Designate) for Weapons. Air Chief Marshal Pelly, who is retiring from the Royal Air Force, has been Controller of Aircraft at the Ministry of Supply since 1956. He will take up his new appointment later this year, and will thus succeed Sir William Penney whose appointment to succeed **Sir John Cockcroft** as Authority Member for Scientific Research has already been announced.

* * *

Mr. M. Robinson—who has been associated with Lancashire Dynamo since 1946—has been appointed manager of the group's Bristol Area office, in succession to **Mr. E. N. Evans,** M.I.E.E., M.Amer.I.E.E.

* * *

The Central Electricity Generating Board announces that **Mr. W. A. Storey,** A.M.I.E.E., has been appointed to succeed **Mr. E. C. Scott** as system operation engineer, North Eastern Division.

Mr. C. R. Wheeler, C.B.E., who has been elected a director of Associated Electrical Industries Limited, is joint managing director of Guest Keen Iron & Steel Co. Ltd., chairman of B.I.S.C. (Ore) Limited, a director of Guest Keen & Nettlefolds Limited, George Wimpey & Co. Ltd., British Iron & Steel Corporation Limited, and other companies.

* * *

Mr. R. H. Burdett, B.Sc. (Eng.), A.C.G.I., A.M.I.Mech.E., A.M.I.E.E., of the research and development department of the Central Electricity Generating Board has been appointed deputy-director (mechanical) in the applications branch, research and development department, of the Board. Mr. Burdett joined the English Electric Co. Ltd., Stafford, in 1946 as a switchgear contracts engineer, and two years later became general assistant engineer in the generation design branch of the former British Electricity Authority. In 1955 he was appointed principal assistant engineer, and later nuclear systems engineer, in the nuclear power branch of the Authority, subsequently taking up the post he now leaves for his present appointment.

* * *

Mr. L. Edgar has relinquished his appointment as group publicity manager of the John Thompson Group of Companies. He will, however, continue to serve the group in an advisory capacity on publicity and Press matters. **Mr. D. H. Edson,** hitherto assistant publicity manager, has been appointed group publicity manager, and **Mr. G. O. Ham** succeeds Mr. Edson as assistant group publicity manager.

* * *

It is with regret that we record the death on July 17th of **Mr. J. G. Kay,** a director of Lafarge Aluminous Cement Co. Ltd., 73, Brook Street, London, W.1, since its inception in 1923, and chairman of the company since 1948.

* * *

It is with regret that we record the death, at the age of 69, of **Sir Frederick Pickworth** (chairman of the English Steel Corporation Limited), which occurred suddenly on July 14th, 1959. Sir Frederick was elected to the board in 1936, becoming managing director in 1944, and assuming chairmanship in 1955. He was a member of the council, executive committee, and a number of other committees of the British Iron & Steel Federation, and chairman of the No. 9 conference of the federation. He was also chairman of the National Forgemasters' Association, and of the Federated Forgemasters, and a member of the management board and various committees of the Engineering & Allied Employers' National Federation.

* * *

Mr. C. A. B. Malden has been appointed joint managing director with **Mr. J. G. Cronk** of Amber Oils Limited.

Mr. Stanley F. Steward, C.B.E., who was appointed director-designate of The British Electrical and Allied Manufacturers' Association on February 1st this year, has now taken up his executive responsibilities as the director of the B.E.A.M.A. **Colonel B. H. Leeson,** C.B.E., T.D., M.I.E.E., relinquished his position as the Director of the B.E.A.M.A. on July 31st. He is now serving in a consultative capacity until he retires in 1960. **Mr. D. Maxwell Buist,** M.I.E.E., M.I.Ex., export director, who has been with the B.E.A.M.A. for 22 years, is retiring on April 30th, 1960, when he reaches normal retiring age. From October 1st, 1959, until that date, he will relinquish full-time executive duties and, like Mr. Leeson, will, during that period, serve in a consultative capacity.

* * *

The United Kingdom Atomic Energy Authority announces that **Mr. S. R. White** has recently taken up a new position as deputy director of public relations to the Ministry of Defence, and will no longer be responsible for Press matters on behalf of the U.K.A.E.A. **Mr. Ronald Truscott** has been appointed acting chief press officer of the U.K.A.E.A., and **Dr. Horace Manley,** technical press officer, is shortly to assume the post of chief science writer, assisted by **Mr. E. Schoeters.**

* * *

An amalgamation has been arranged between **The Wallsend Slipway and Engineering Co. Ltd.** and **Hubbard Combustion Limited.** With this fusion of the oil-burning interests of the two companies, they will be able to place their combined experience and resources at the disposal of their clients, and close collaboration on research and development will undoubtedly result in even greater efficiency in the well-known Wallsend and Wallsend-Hubbard systems of oil-burning.

* * *

The Institution of Electrical Engineers states that the result of the ballot to fill the vacancies which will occur on the council on September 30th next, is as follows: President, **Sir Willis Jackson,** M.I.Mech.E.; vice-presidents, **Mr. G. S. C. Lucas** and **Mr. O. W. Humphreys**; honorary treasurer, **Mr. E. Leete**; ordinary members of council, **Professor H. E. M. Barlow,** M.I.Mech.E., **Mr. C. O. Boyse,** M.Inst.C.E., **Mr. L. Drucquer, Mr. H. G. Nelson,** M.Inst.C.E., M.I.Mech.E., **Mr. J. R. Rylands,** M.Sc., M.I.Mech.E., and **Dr. G. A. V. Sowter,** associate member, **Mr. R. A. Hore,** A.M.I.Mech.E.

* * *

The Newcastle office of **Lancashire Dynamo Group Sales Limited** has been moved to new premises at Eagle Star House, 32-34, Mosley Street, Newcastle upon Tyne, 1. The telephone numbers remain unchanged:—Newcastle 28621 and 29736.

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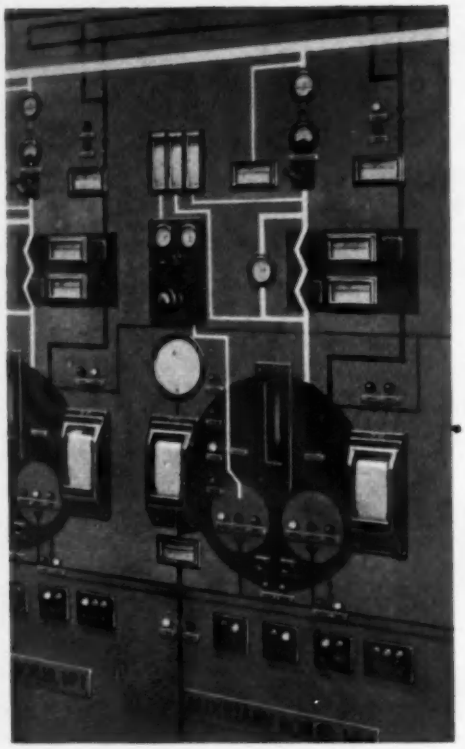

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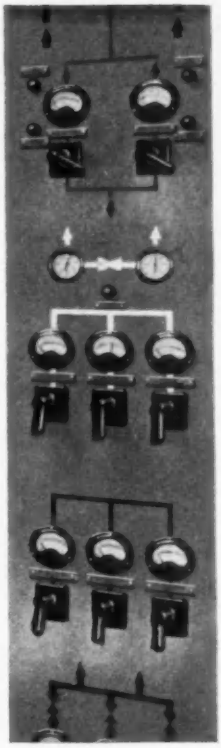

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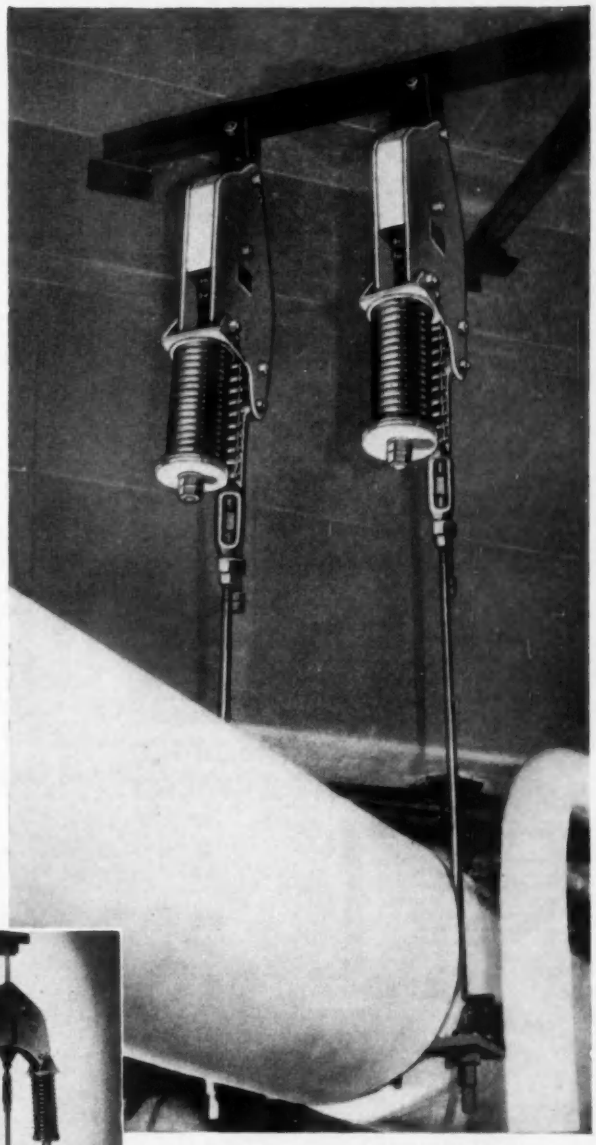

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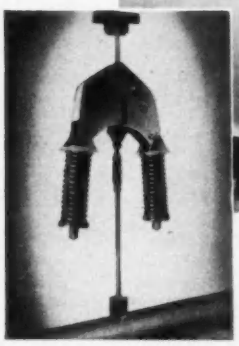

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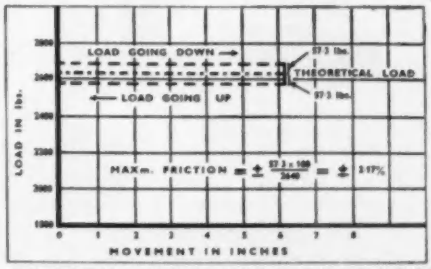

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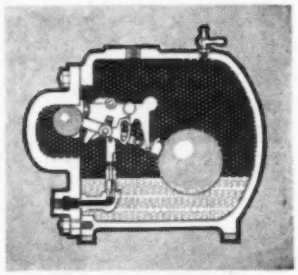

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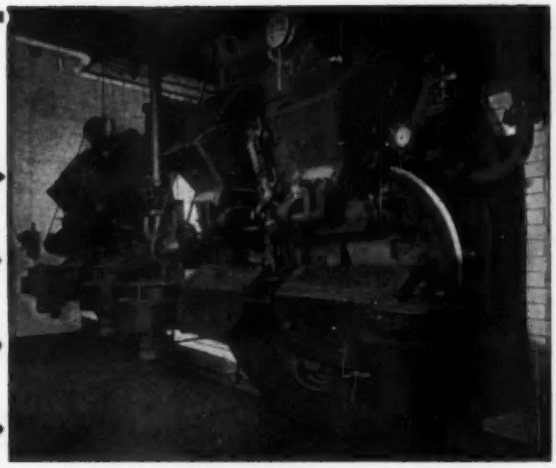

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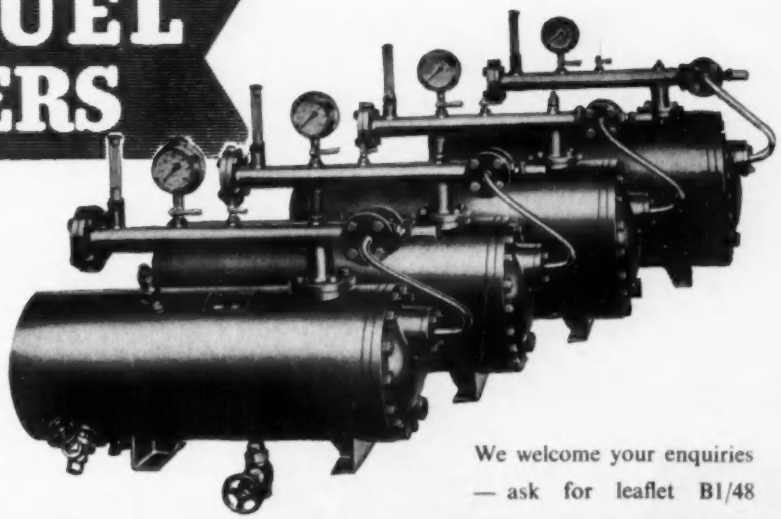

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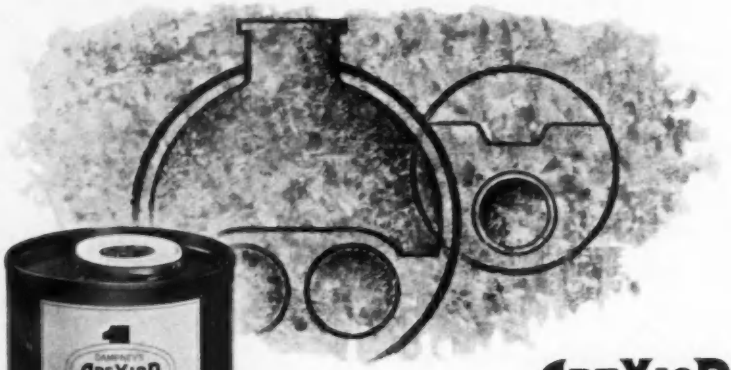

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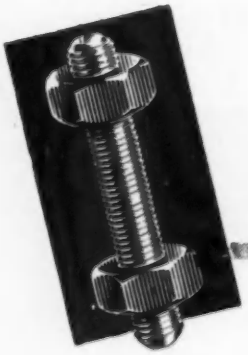

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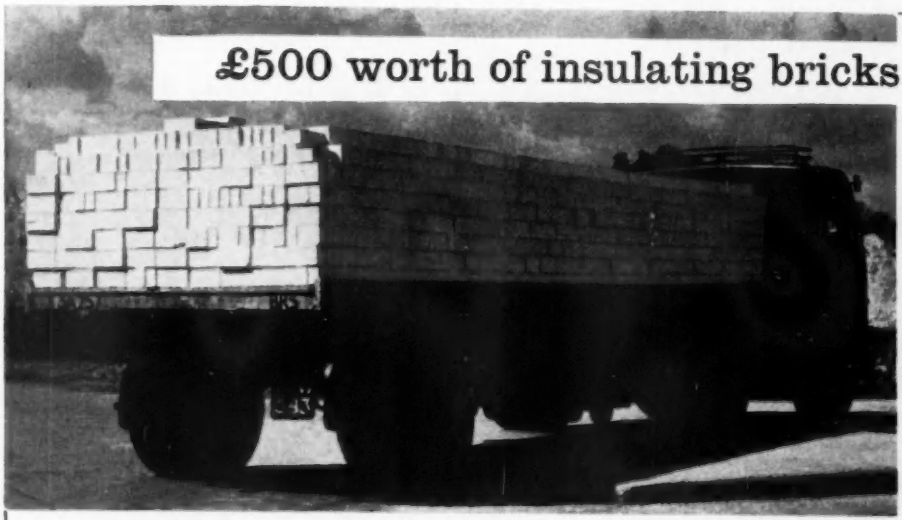

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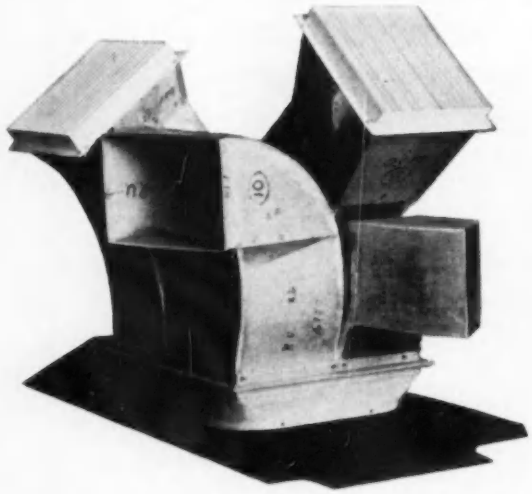

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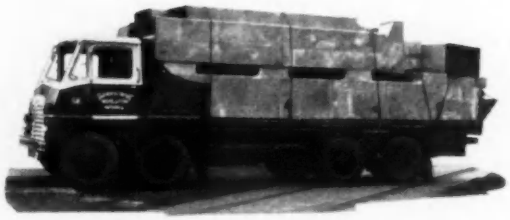

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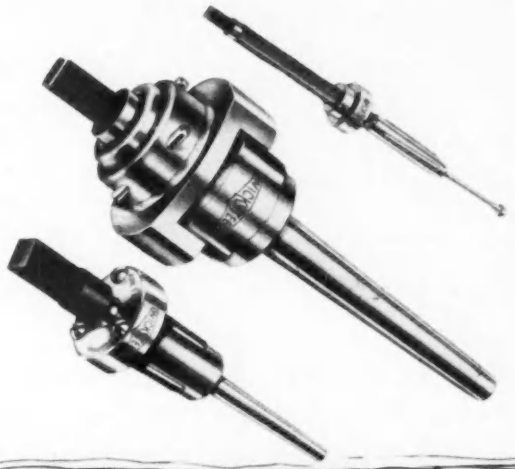

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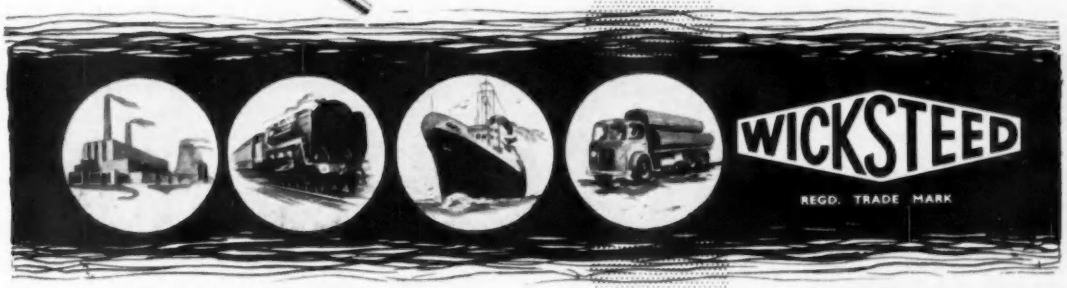

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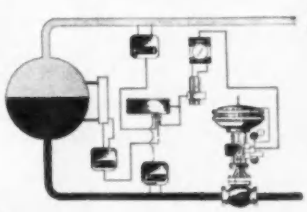
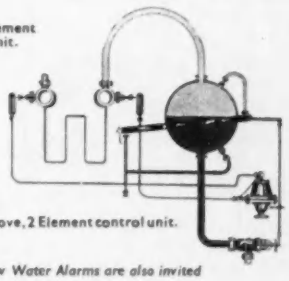


Left, 3 Element control unit.



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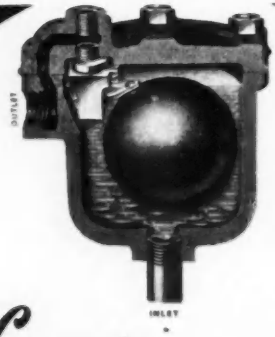

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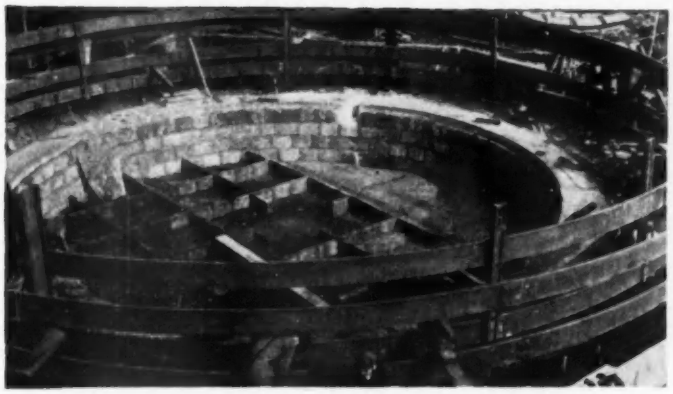

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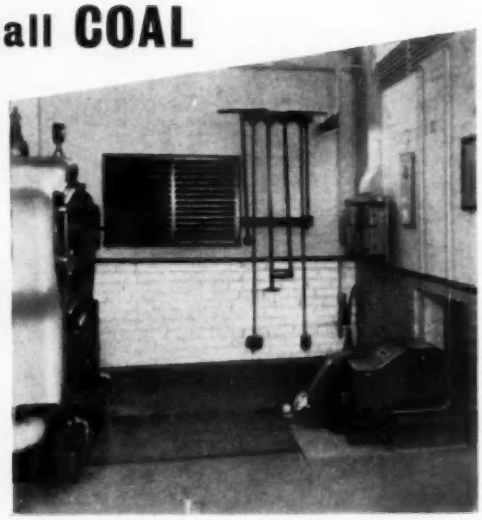

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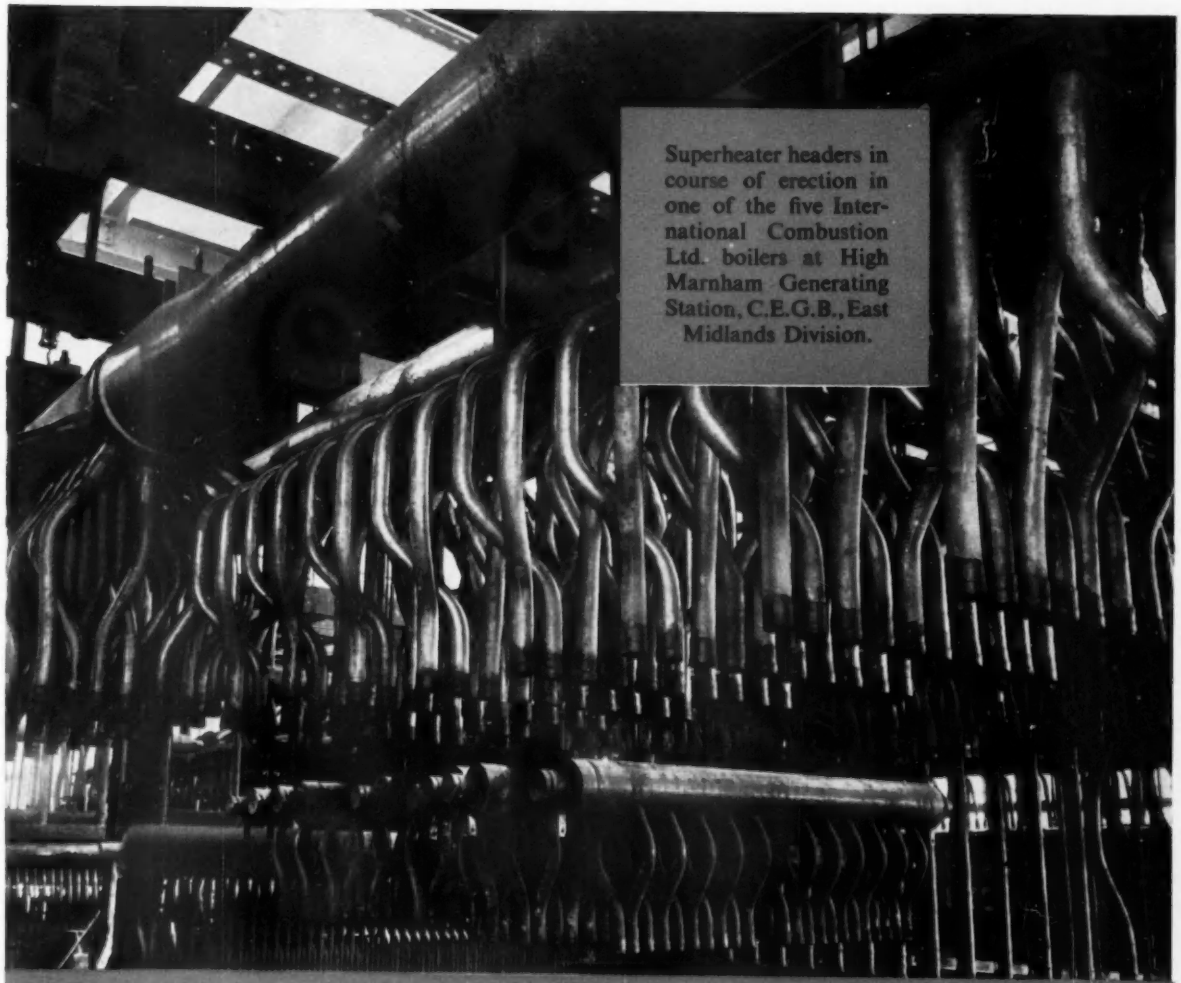

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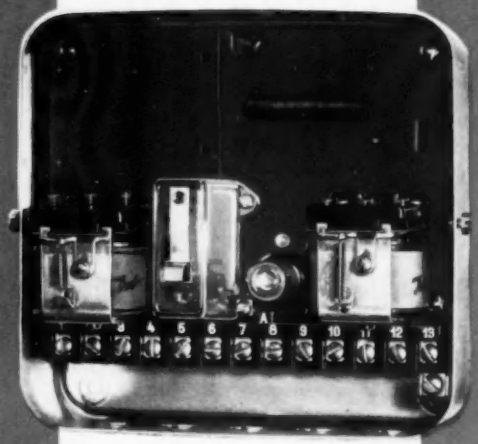
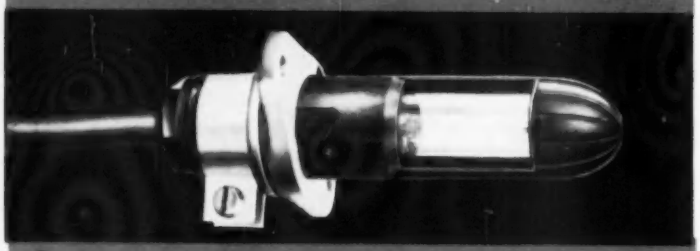
PHOTO RESISTOR FLAME CONTROL ON CONTROL BOX





CFS

operating direct on the relay without any amplifier circuit

A semi-conductor photo-resistor as flame control is the brand new feature that made it possible to design the new CFS.

The flame control circuit, which converts the impulses from the photo-resistor, is made of sturdy reliable components, that

do not "wear out" or break down
and replacement of such parts will not normally be required

When the plant is started, the timer of the safety relay is connected. When the flame has been established, ignition and timer are cut out of circuit. The safety relay will trip if ignition fails, both when starting and in case of automatic attempts at re-starting the plant.

—a CFS unit means a maximum of security
and a minimum of service.

everything under Danfoss control

Please ask for literature

Danfoss

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